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Data Visualization: Detailed Study Of Tools And Its Applications

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Abstract

Background and Research Problem – Presentation is one of the best ways to influence other parties. For example, company is presenting the progress of performance in the form of a table or verbal data presentation; it is significant to show data by using a graphical method or other creative dashboard to have a positive impact on stockholders. Data Visualization (DV) changes crude information into numerical and pictorial dimensions that recount a story. In today's era, several software packages are available in the market for data presentation and visualization. Every company should try to incorporate these software's into their operation to increase efficiency but on the other hand, It is also necessary to know about these softwares' pros and cons and use their benefits according to the company's requirements.

Objective –

- To explore the Concept of DV.
- To know how DV is useful in the different areas of working.
- Identify and discuss various DV tools for the organisation.

Data Collection and Research Method – Secondary Data and fundamental research were used for the research purpose.

Finding and Conclusion – Having a set of data is not sufficient for decision-making purposes. It is necessary to know the story behind data and what it says. The powerful DV platform enables business firms to present their data with actionable insights drive, valuable decision-making and improve all working performance. It becomes necessary for business firms or managers to be familiar with this software to be effective in current market trends.

KEYWORDS- Data Analysis, DV, MS Excel, Power BI, Tableau, Tools for Visualization

INTRODUCTION

Everyone wants to increase the number of the followers and views on Facebook, so what is the best way to do so. The attractiveness, creativity is the solution for the problem. This trick is also applicable to business organisation for data and report presentation. Raw data does not provide any information; there is a need for analyzing the data. Humans are attracted to pictures or graphs instead of tables which is the biggest reason for the growth of Data Visualization (DV). In the era of big data, DV is one of the significant components in the field of business intelligence which allows analysts to prepare creative dashboards for meaningful presentation of information. The visualization and interpretation of data have become a required skill in today's business world. It enables the user to make decisions within a short period of time as it converts raw data into a creative dashboard which requires less time for understanding.

DV is required to analyze huge amounts of information. Data analysis is a more useful technique than ever, with sophisticated applications or tools that enable a business of all sizes to collect data related to customers & operations and rising competitive pressure from other companies working in the same industry. DV provides a better presentation of the information and data with the help of a graphical or picture format. DV is a tool that helps the analyst to know the trends, fluctuation, and patterns in a data set. Many organisations are dealing with huge amounts of data and sometimes it becomes impossible for them to make some decisions if data are not properly presented. DV is a helpful hand for managers to analyze massive sets of data and information. DV is more common in our day-to-day life and always appears in the form of Graphs and images. The combination of multiple graphs is called Info-graphics. The basic objective is to know the unknown fact hidden in a data set.

Data visualization (DV) plays a key role in process of decision-making by providing a clear insight into data or information for decision-makers. It presents data more engagingly and in comparative format. By using graphical or pictorial formats, DV highlights both the positive and negative aspects of information in a way that is easier to understand. This method is particularly effective for sharing information with stakeholders, as graphs and pictures often convey insights more effectively than tables.

In a business context, DV helps to establish relationships between various factors affecting the firm. For instance, it can illustrate how the online market experiences a surge during festive seasons compared to regular days. Additionally, DV is valuable for finding trends in variables such as sales, profit, and production, and for forecasting future values based on current trends. It supports both long-term trend analysis and real-time data analysis.

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Human beings are naturally more attracted to visuals than to text-based reports, making DV is a powerful tool for quick comprehension and action based on data insights. By presenting vast amounts of data creatively, DV enables decision-makers to grasp important information and understand how different variables affect business performance. Moreover, visualization can aid in detecting errors or inaccuracies in data promptly.
However, creating effective data visualizations can sometimes be a time-consuming process, especially in the case of huge and complex data sets. These lead to slow down machine learning and reduced efficiency. Sometimes, DV can mislead anyone if it is not properly made. Additionally, if not designed properly, visualizations can be misleading. Handling missing data in DV is a typical task and an analyst may remove some data due to large volumes and cleaning of data is also time-consuming process. Data may be important for someone and insignificant for others. Not everyone is capable of finding missing data in visualization. The risk associated with DV is that viewers can misinterpret information because of poor visualization. Sometimes, a visual medium can lead to confusion in the mind of the viewer.

LITERATURE REVIEW

M. Islam and S. Jin (2019) The authors have done their study on An Overview of Data Visualization. The objective of their study was to gain knowledge of DV and they studied its advantages, challenges, tools, and applications. The study revealed that DV converts small and large segments of data into a visual chart which is attractive and easy to understand.
Liu, J., Tang, T., Wang, W., Xu, B., Kong, X., & Xia, F. (2017), The authors have done their study on A Survey of Scholarly Data Visualization. In this paper, they studied the introduction and basic concept of DV, technique, collection of data, and tools for visualization. The issues or problems related to visualization were discussed to find a solution.
Telea, A.C. (2007), This author wrote a book on Data Visualization - Principles and Practice which is related to DV, and gives knowledge of DV like how to represent data, convert data into graphs or images, principles of DV and also enables the reader to gain knowledge about various important aspect of DV.
Midway SR, (2020), The authors have done their study on the principle of effective Data Visualization. The objective of this paper was to provide clear-cut knowledge about the principles of DV. He told ten principles that are necessary for effective visualization like colour always means something, including uncertainty, Panel when possible, and simple visuals with great information etc.
Pant, Anjali, & Rajput, R.S**.** (2019) The authors have done their study on Introduction of Research Data and Its visualization Using R. The main theme of the study was R Software. The author explained the fundamentals of data, the nature, and collection, of data, data model, and database management. The author also explained visualization with the help of R.
Siddiqui, A. T. (2021), The author has done their study on Data visualization: A Study of Tools and Challenges. The objective of the study was to study the various software used for visualization purposes and the challenges of adopting the same. The study concludes that data visualization is in trend and becoming a need for every company due to solving complex data tasks.

RESEARCH METHODOLOGY

Research Problem – DV enables the user to convert the information and data into pictures or a graphical manner for easy understanding. It helps to make decisions with a deep insight into data and is also helpful for the creation of a relationship between two or more variables to know how they affect each other. We are living in a data-driven world, where it is most important to understand the data more simplistically. In today's time, the need for data presentation skills is increasing year by year. Every business manager or owner has to make several decisions, and they must understand the data and its impact on the organisation.

Objective of Study

- To explore the Concept of DV
- To know how DV is useful in the various areas of working
- Identify and discuss various DV tools for the organisation

Type of Research and Data Collection- For the purpose of study, data is collected from secondary sources. Secondary data is a type of data that is ready & available and the author is using it for the second time. The data was collected through journal, books, and articles available on Internet.
Methodology- The basis or fundamental research was used to achieve the research goal. Information was taken from different sources like journals, books, and internet sources and arranged fruitfully.
Limitations- The research paper is theoretical in nature and includes only theoretical aspects of DV like concept, application, tools and principles.

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HOW DV SOFTWARES WORKS

Figure 1 How DV Softwares Works

- Sourcing Data – DV software can import data from a cloud-based system or online mode as well as offline mode from your system in the form of Excel, CSV, XML, etc. Some can import data up to one GB.
- Transforming Data- Cleaning and manipulation of data is done in the second step. The data may have some unrelated value or missing value which may affect the final result. So, it is necessary to remove unwanted data.
- Report and Publish – In this step the report is created which is based on requirements and different filters and constraints represented in the form of graphs, pie charts, etc.
- Creating Dashboard- The Dashboard is created by pinning independent variables to the live report.

TOOLS FOR DV

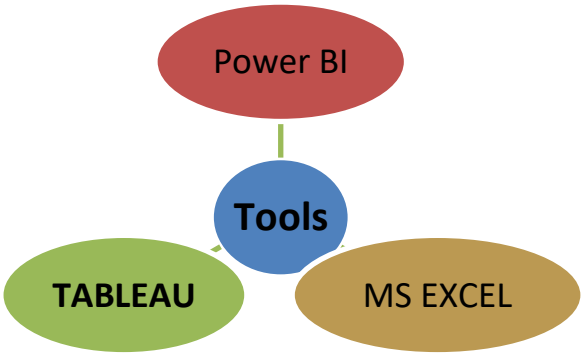

Figure 2 Tools of DV

1. POWER BI

Power BI was launched in the year 2014. It is one of the powerful data analytics and visualization tools developed by Microsoft to transform raw data into creative, informative reports and dashboards. Power BI is a tool that is used to visualize data and share it with another party. It collects the raw data from various sources and converts it into creative visualization for decision-making. Microsoft Power BI is available in free and paid version. (Microsoft Corporation. (n.d.). Power BI: Business analytics.)

Power BI Desktop – It is set of simple and limited feature for the purpose of visualization and analysis. It is free version available to customer.

Power BI Pro – It is cloud based Saas application which provides unlimited viewing, sharing dashboard with large audience.

Power BI Embedded – It is license which allows embedding Power BI Dashboard and report into

Power BI Premium – It is cloud based option for organisation that need high performance insights and

Power BI Mobile – It allows the user to views report on mobile.

Feature of POWER BI

- Power BI helps in making creative dashboards and reports that show data in graphical or other form.
- Power BI enables various users to work at the same time on the same datasheet. It makes it easy for a team member to share information and insight.

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- It transforms raw data by cleaning and manipulation processes to the useful information. The Cleaning process reduces the chance of error.
- Power BI can do the work in collaboration with various software like teams, excel, share- point.
- Power BI free version is available, and it is also a cost-effective tool. In the case of a small firm, it may be costly.
- Compared to other tools, it is not easy to understand.
- It is suitable for large and complex data sets.
- For real-time analysis, it is a perfect tool.
- It requires stable internet and it has fewer financial analysis and calculation functions.

Company Using Power BI

1. Hewlett Packard
2. Rolls Royce
3. Metro Bank
4. Kraft Heinz
5. Rockwell Automation

2. TABLEAU:

It was released in the year 2003. Tableau is a Business Intelligence tool to makes a creative dashboard in the form of charts, graphs, images and shares it with others. This software enables the user to make business-related decisions by simplifying the data. To make a dashboard in Tableau, we need to get data from offline or online mode. It can also get data from a server or can use Excel or CSV etc. files. (Tableau Software. (n.d.). Tableau: Business intelligence and analytics.)

Tableau has several versions namely-

Tableau Desktop – It is core product with simple and limited visualization options. It is self-hosted application that allow user to connect various data source to create dashboard.

Tableau Online – It is cloud based system that allow user to share dashboard to large audience.

Tableau Server - It is powerful tool which allows organisation to share dashboards within organisation.

Tableau Reader – It is free version of tableau desktop that allow user to view and interact with dashboards created on tableau desktop.

Feature

- Tableau is also helpful in the creation of dynamic visualization of data. It is also helpful in cleaning the data.
- It provides understanding the data from different perspectives.
- Tableau is created with a simple interface that everyone can understand it. No coding experience is required. It is very user-friendly.
- Tableau can connect with servers and, the internet to get data and it also uses various files like Excel, CSV, SQL and other extensions of files.
- It is expensive for small business firms.
- Limited integration with Microsoft.
- It performs very well with a large data set.

Company Using Tableau

1. **Honeywell**
2. **EY**
3. **Nissan**
4. **Heathrow**
5. **Wipro**

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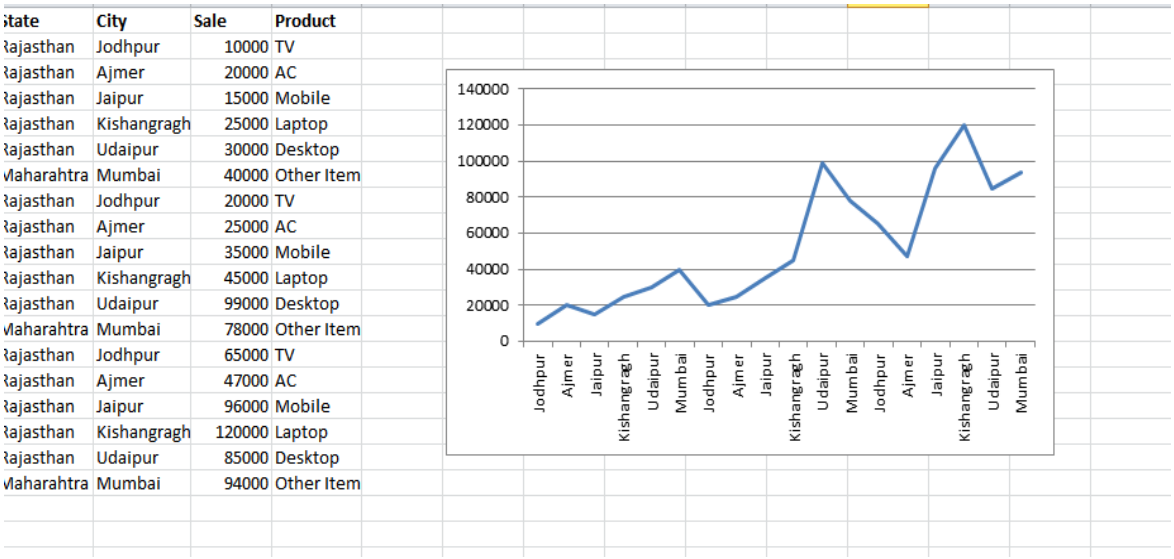
3. MICROSOFT EXCEL

According to Walkenbach, J. (2018), It was released in the year 1985. MS Excel is not only helpful in mathematical calculation but also provides an option for DV. It also provides various types of charts, shapes, and smart charts to show data. Tableau and Power BI can be integrated with Excel. MS Excel visualizes the data set in various types of charts like Bar charts, Column charts, Pie charts, and Line charts. Pivot is one of the best options in Excel which summarizes the data according to different variables. It is helpful in mathematical calculation.

Features –

1. It is easy to understand.
2. It is the old and accepted application of Microsoft.
3. It is helpful in data analysis and presentation with various uses of formulas and graphs.
4. It is useful for analytics and calculation work.
5. It has a limited scope for data presentation.

MS EXCEL VISUALIZATION



State	City	Sale	Product
Rajasthan	Jodhpur	10000	TV
Rajasthan	Ajmer	20000	AC
Rajasthan	Jaipur	15000	Mobile
Rajasthan	Kishangragh	25000	Laptop
Rajasthan	Udaipur	30000	Desktop
Maharahtra	Mumbai	40000	Other Item
Rajasthan	Jodhpur	20000	TV
Rajasthan	Ajmer	25000	AC
Rajasthan	Jaipur	35000	Mobile
Rajasthan	Kishangragh	45000	Laptop
Rajasthan	Udaipur	99000	Desktop
Maharahtra	Mumbai	78000	Other Item
Rajasthan	Jodhpur	65000	TV
Rajasthan	Ajmer	47000	AC
Rajasthan	Jaipur	96000	Mobile
Rajasthan	Kishangragh	120000	Laptop
Rajasthan	Udaipur	85000	Desktop
Maharahtra	Mumbai	94000	Other Item

Figure 3 MS Excel Visualization

POWER BI VISUALIZATION

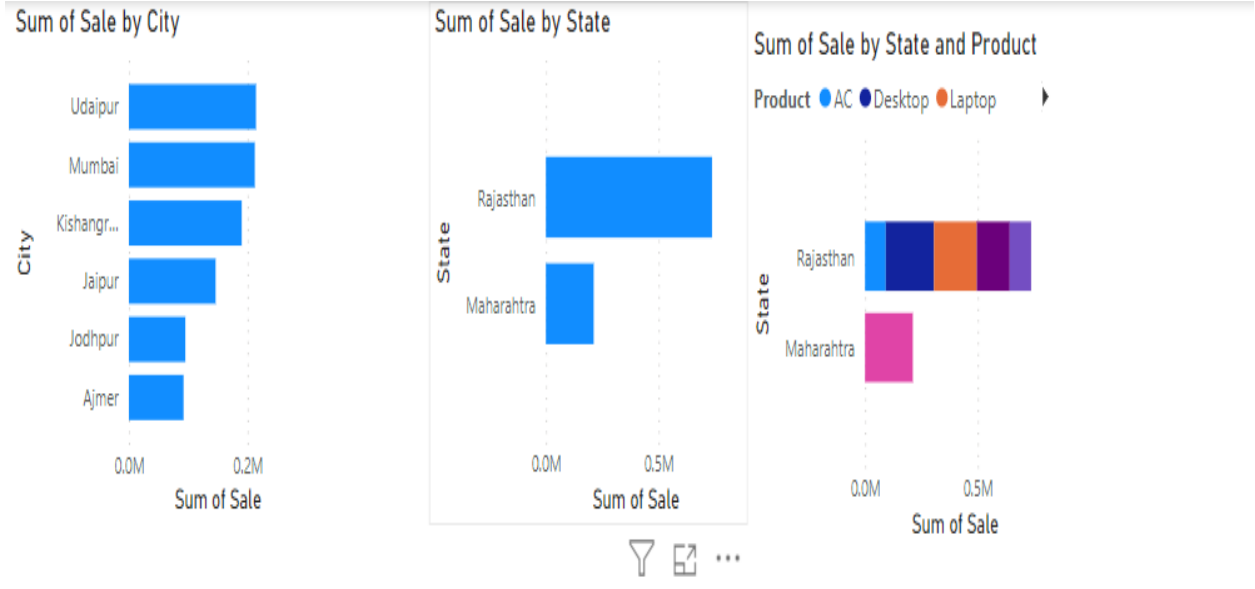


Figure 4 Power BI Visualization

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TABLEAU VISUALIZATION

Figure 5 Tableau Visualization

APPLICATION OF DV

- **Health Care Industry -** The Health care industry receives data related to patients, hospitals, doctors, and types of Illnesses. It is useful for researchers and the government sector as well. The Government can make plans accordingly like whether is there any requirement for an increasing number of hospitals, or doctors or not. Visualization software allows us to make relationships between two variables and analyze their overall impact.

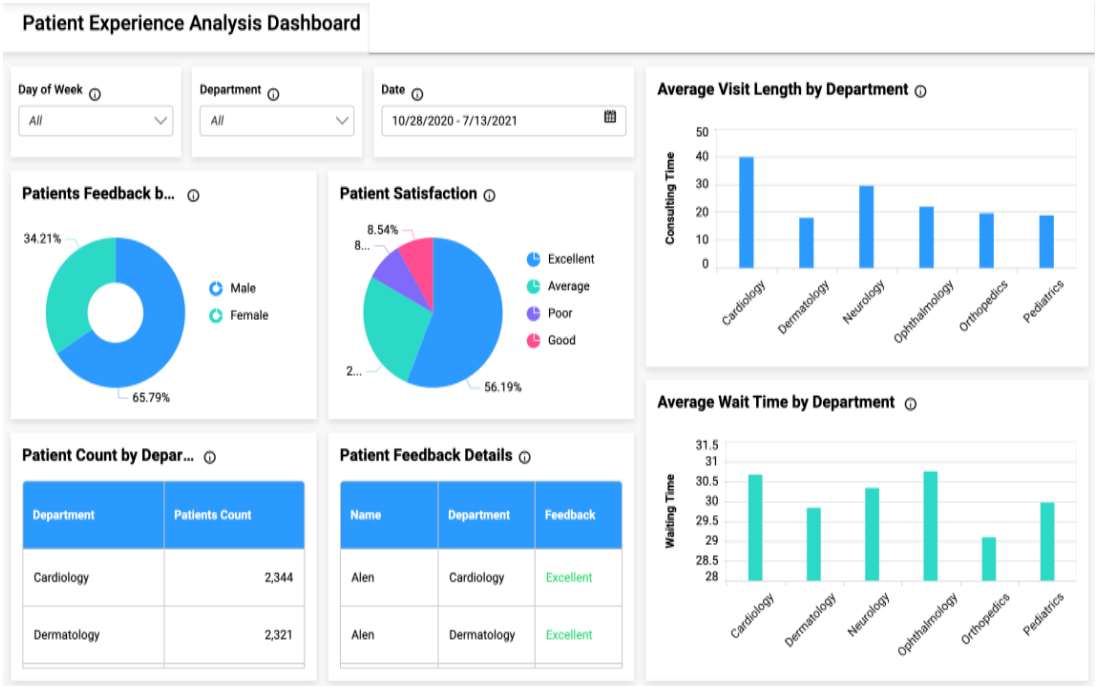

Figure 6 Application of DV in Health Care
Source:- https://demigos.com/blog-post/healthcare-data-visualization/

- **Finance Industry –** Financial data visualization is method of shows financial data like profit and loss, cost of product, current ratio and other finance data into picture or graphical form. When company uses data visualization, it helps the user to know the beyond the data. Traditional methods are complex because of the huge amount of data to interpret. DV helps finance managers showcase finance data simply and creatively for easy understanding of information. Finance managers can use visualization for tracking purposes over specific expenses like revenue or capital, seasonal patterns, capital structure, and different types of ratios.

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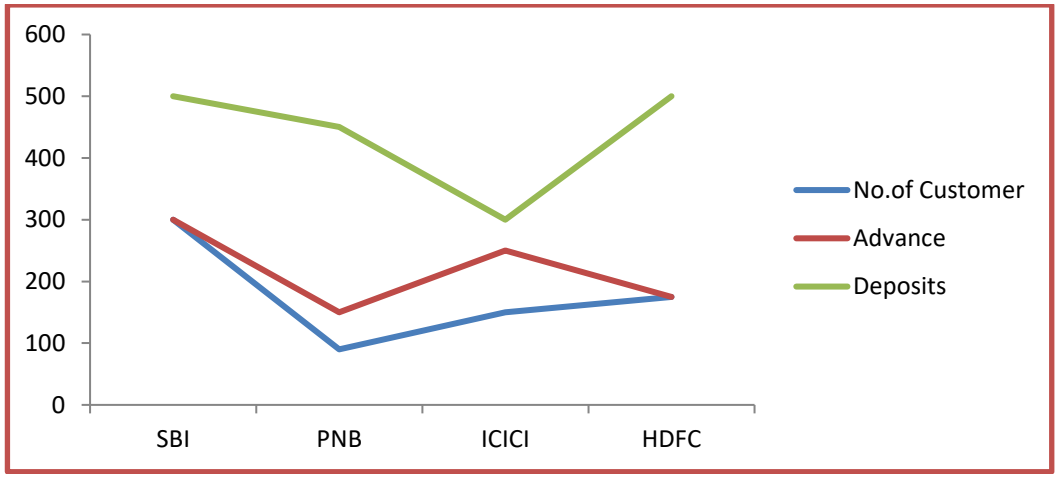

Figure 7 Application of DV in Finance Filed
Source – Imaginary Figure – Use of MS Excel

● **Market Research -** For this type of research, visualization is a boon. It provides insight related to customer patterns, sales, product-wise demand, future needs for products or services, campaign effectiveness, advertisement effectiveness, segmentation, and customer satisfaction. DV presents numerical and categorical data which helps in understanding information and reduces the risk of analysis of paralysis. For example, a marketer can use DV to track the impact of the marketing channel over the sale of a product.

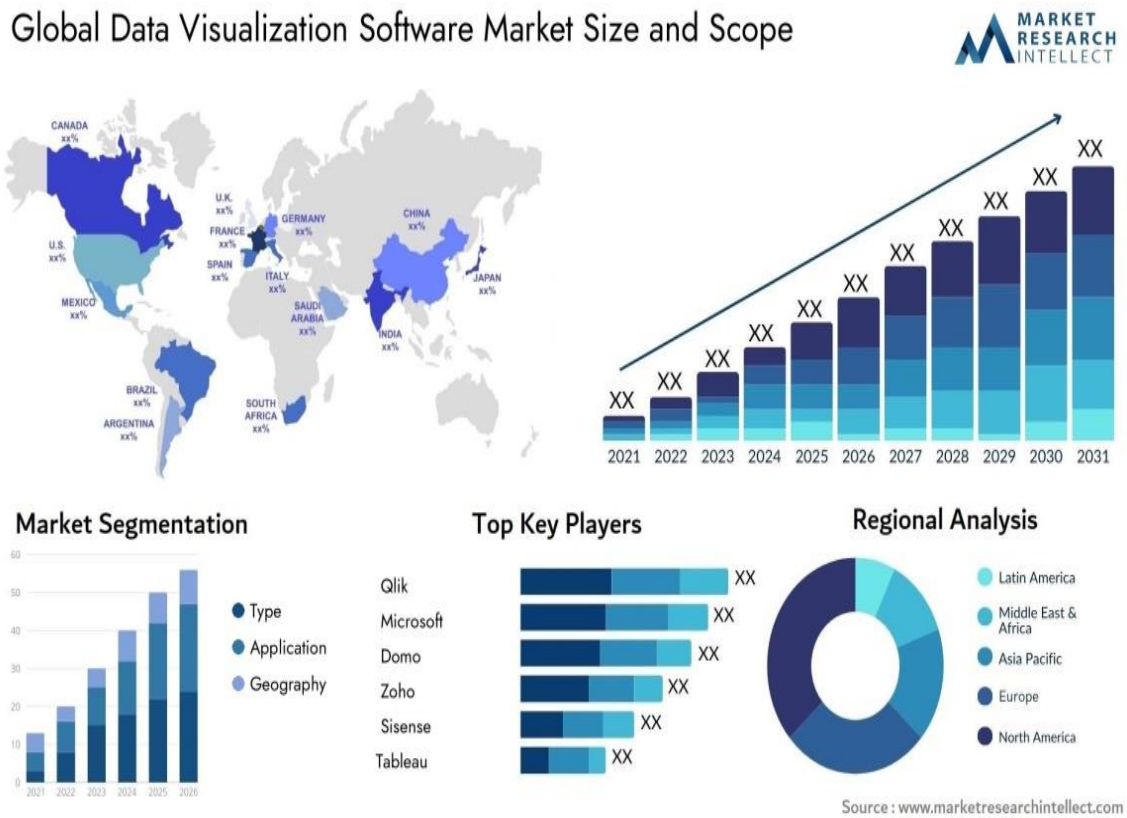

Figure 8 Application of DV in Market Research
Source:- https://rb.gy/l5nw9h

● **E-Commerce and Retail -** DV plays a crucial role in E-commerce and retail by optimum utilization of inventory management, analyze the demand for products, consumer behaviour and improve supply chain management. For example, it can create a relationship between E-Commerce trade, customer browsing website and purchasing decisions. Traders can also know the buying habits of buyers.

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Figure 9 Application of DV in E- Commerce
Source – http://surl.li/sfngtl

- **Education-** In this filed, DV helps to know the student performance, identify learning outcomes, or impact of education policy over schools or colleges. The education institute can track student performance over the year or exam wise and know which subject requires more attention. It also promotes accuracy, transparency, and accountability in the education sector. Education stockholders can analyses institute performance, gaps, and hold departments as individuals or groups for failure or success for the institute.

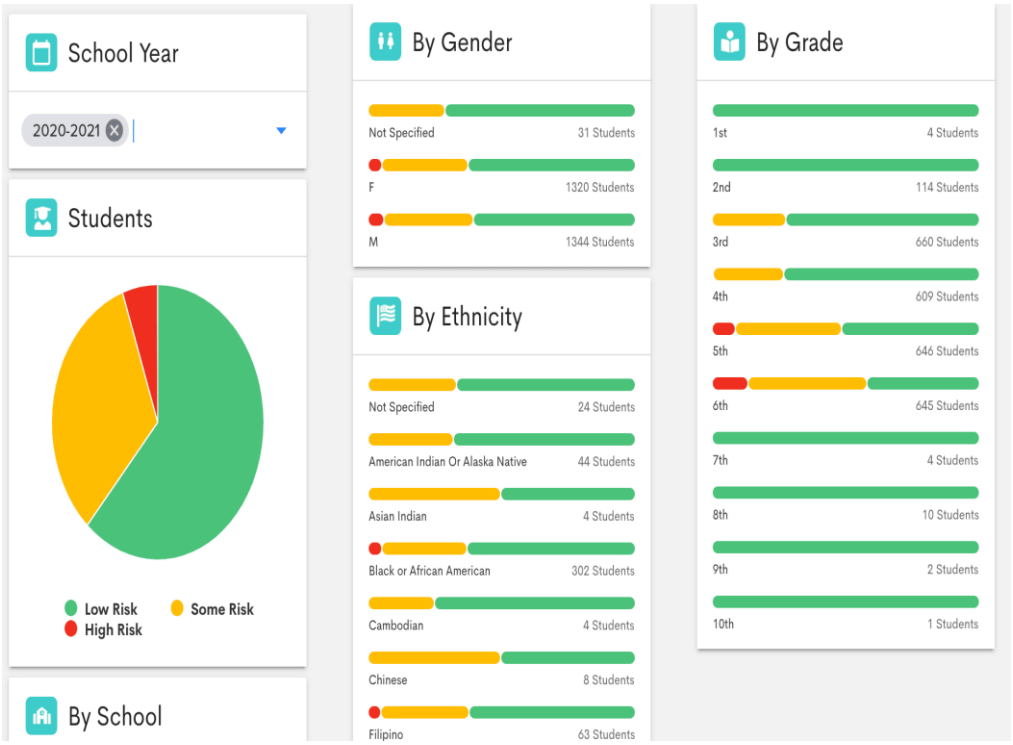

Figure 10 Application of DV in Education
Source:- http://surl.li/qudrry

- Food Delivery app- DV helps food delivery from tracing orders to predicting consumer behavior for future purchases. It helps the food company to keep recording of order per hour, inventory management, reduce waste, what is expected delivery time, volume of orders during the festive season, and also optimize delivery route for timely and efficient delivery of product. For example, through DV, analytics can find out best profitable dishes and best time to

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launch promotional offers. Another example, sales figures on holidays are higher in comparison to other working days, in that case, company can arrange additional staff and can stock high demand products.

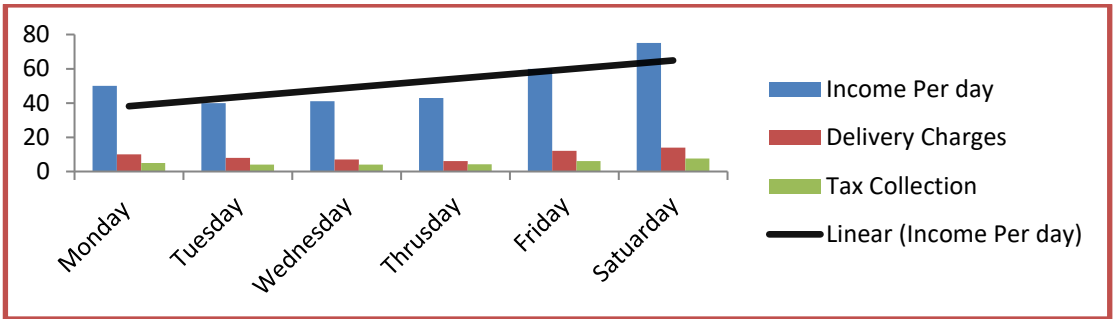

Figure 11 Application of DV Food Delivery App
Source – Imaginary Figure – Use of MS Excel

- Sports – DV is also helpful in sport activity, which enables us to know players insight like performance trends, team statics, compare players, and injury patterns. It is helpful for players or business firms to get insights into their performance and find out the area for improvement. For example, a player performance in cricket can be shown as follows:

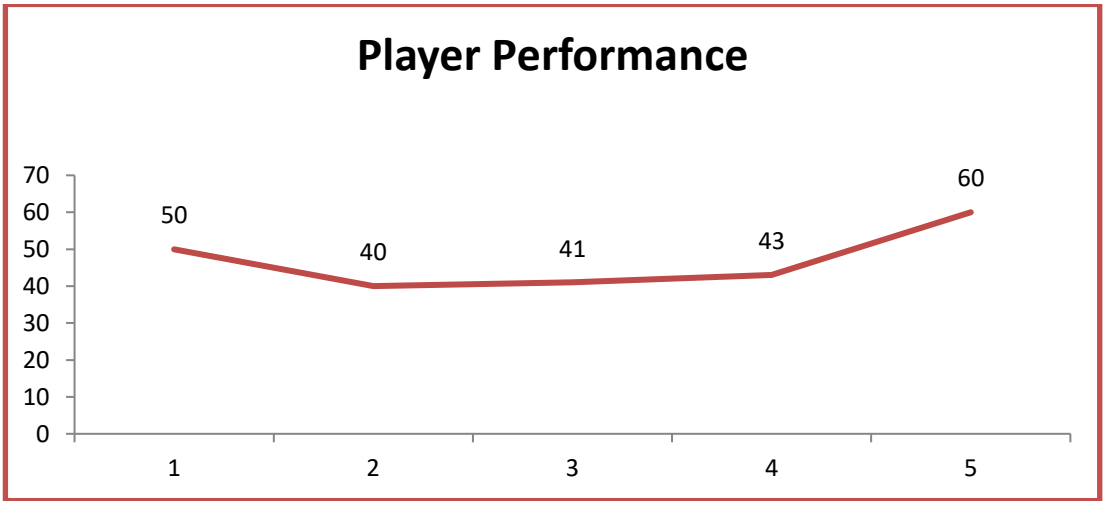

Figure 12 Application of DV in Sports
Source – Imaginary Figure – Use of MS Excel

- Humanities- DV is useful in literacy analysis, culture trend analysis, maps, timelines, and historical data analysis. Culture analysis involves analyzing cultural data like music, films, customs, with the help of various graphs, and also helpful in analyzing the relationship between two variables like traditional societies and movies.
- Environment Analysis- DV is also helpful in monitoring, analyzing complex Environmental data and provides significant information to a wider audience. The Environment data includes information related to air quality, water quality, pollution, weather, satellites, and sensors. This enables us to know the pattern and trends, the impact of the environment on society, and planets for effective decision-making. For example, if a company uses high energy and affects air pollution, it can identify areas where it can make changes to reduce energy and pollutions. It is an important tool for business firms that are looking to improve their environment performance. By collecting, integrating, and analyzing information from different sources, a firm can get a better understanding of the environment and can modify their business working style accordingly.

PRINCIPLES OF EFFECTIVE DV

1. Use Colour Wisely. Colour attracts viewer's attestations. However, the extreme use of colour is a negative point. Colour also says story like red colour shows a loss, so use colour according to their trait.
2. Data contains several pieces of information. While preparing DV, the analyst should highlight the crucial information which is required for decision-making.
3. Try to avoid clutter. If you are trying to accommodate numbers information in a single visual then follow top to bottom form means the top presents important information and progressively go down accordingly.

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4. Use a table, when you want to show precise value and on the other hand, graphs should be used in case of showing trends, relationships, or changes in value over a period.
5. Explanatory titles should be given to graphs or charts. It helps the viewer to know the snapshot of the theme.
6. Chart junk should be avoided. Unnecessary grid lines, decorations, colour and text should be avoided. Using old-fashioned or fancy charts creates difficult to understand.
7. Data must be valid. There should be a link chain among data. Unlink data may create confusion or there may be duplicity of data.
8. Just showing data in a graph is not sufficient. To engage the audience, you should add narration to your data. This makes your message and data meaningful to the viewer.
9. The massive set of data required high computing power with a high-speed processing system to visualize data in real time. So, the computer system of analysts.

FINDINGS & CONCLUSION

In a nutshell, it can be concluded that DV play a significant role in every sector including education, health, social science, and etc. due to the huge volume of data. Data are dumb, and it is necessary to know the story behind them that's why the company uses some management accounting techniques & other techniques as per requirements and shows the results in pictorial or graphical form for easy understanding. Using DV makes it possible to understand the complex set of data, identify the trend and communicate the powerful insight of the company to interested parties. It offers valuable insight for decision-making purposes to various industries, for example in the finance function, it enables the company to keep track of income or expenses, in the case of education, it enables education institutes to track student performance and in the marketing industry, it helps the marketer to know the behaviour of consumers. DV is in a growth phase and most companies are using DV software like Power BI, Tableau, Excel, and others. All software has its own positive and negative aspects and the use of software depends upon the requirements of the firm. The effectiveness of visualization depends upon the type of data, graph, an important point of the data set, and colour selection. It is also important to consider the colour, materiality of information, and type of chart for preparation of visualization.

REAL LIFE EXAMPLE OF COMAPNIENS USING DATA VISUALIZATION

1. Netflix It uses DV in order to fulfil its objectives related to customer, market share, productivity and communication. With the use of DV, managers can access real-life information, data, monitor the company activities, and can make some informed decisions on predicative analysis.
2. Walmart – With the help of DV, Walmart can predict the future demand of product by analyzing the sales data from various stores and online mode. It ensures that each store has a sufficient number of items in stock. Walmart use an effective and interactive dashboard which helps manager to know the sale trend and profitability of each product.
3. Uber Pricing Model – It use DV to surge pricing during a peak time period. Through maping and pricing, both driver and passenger can see price in real time world which help them to take decision regarding the ride.

FUTURE SCOPE

This study is restricted to only the introductory part of Data visualization, Excel, Power Bi, and Tableau. Another researcher can explore the present research study by comparing more data visualization tools or by focusing on a particular area of application where the study of DV can be used in-depth to determine the efficiency of DV in that area.

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