EXPLORING THE EVOLUTION OF HUMAN RESOURCE ANALYTICS AND ITS IMPACT ON ORGANIZATIONAL PERFORMANCE

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Abstract*:* An HR dashboard is an analytics tool that uses interactive data visualizations to display HR metrics, improve recruiting processes, and enhance employee performance. It helps in analyzing compensation, benefits, and workplace management. HR analytics can predict promotion chances and attrition rates using machine learning algorithms. It can significantly enhance HR leaders' decision-making on human and organizational capital, resulting in improved employee performance and an optimal return on investment. Integrating Power BI and Tableau into HR analytics facilitates comprehensive data visualization, enabling HR professionals to create interactive dashboards and reports. SQL comparison adds another layer of analysis by facilitating data consolidation, cleaning, and querying across disparate HR systems, ensuring data accuracy and consistency. The journey begins with an overview of HR analytics' historical development, highlighting the shift from traditional reporting to advanced predictive modeling and data-driven strategies. Integrating machine learning algorithms represents a significant milestone in leveraging HR data for competitive advantage and operational excellence.

I.INTRODUCTION

Human resources analytics involves using data and statistical analysis to gain insights into various aspects of an organization's workforce. This field focuses on collecting and interpreting data related to human resources processes, employee performance, and overall organizational dynamics. By leveraging analytics, businesses can make informed decisions to optimize their HR strategies, improve employee engagement, and enhance overall organizational performance. Integrating Power BI and Tableau into HR analytics facilitates comprehensive data visualization, enabling HR professionals to create interactive dashboards and reports. SQL comparison adds another layer of analysis by facilitating data consolidation, cleaning, and querying across disparate HR systems, ensuring data accuracy and consistency. The journey begins with an overview of HR analytics.

Analytics for human resources (HR) is a comprehensive strategy to enhance decision-making capacity to accomplish organizational objectives. In HR analytics, advanced predictive modeling is applied in situations where the company must predict the outcomes of corporate or organizational policies [2]. The majority of businesses don't take a broad approach to workforce development, which calls for predictive human resources analysis. development, emphasizing the move away from conventional reporting and towards sophisticated predictive modeling and data-driven tactics. For the organization to develop various aspects of the business, such as IT and financial skills for better ROI (Return on investment), operational excellence is required. Integrating machine learning algorithms represents a significant milestone in leveraging HR data for competitive advantage[2][3]. utilizing HR dashboards to assist with pertinent HR procedures Analytics for human resources (HR) is a comprehensive strategy to enhance decision-making capacity to accomplish organizational objectives[6]. Utilizing an HR analytics platform, contemporary interactive dashboards facilitate the seamless integration of data from many systems and enable in-depth analysis of said data within the dashboard itself.HR departments may then swiftly identify trends to boost employee performance, optimize workplace management, and improve recruiting.[7] HR departments and business managers can better according to Steven McCartney and Na Fu's research paper "Bridging the Gap: why, how, and assess their workforce's efficacy, contentment, and goal progress with the use of employee performance dashboards. This project displays the number of active employees by rating level and salary by employee rating to analyze remuneration vs. performance [7][8].

Since HR analytics is still a relatively new concept, academics are still emphasizing how HR analytics can help with decision-making and the achievement of organizational goals, according to Steven McCartney and Na Fu's research paper "Bridging the Gap: why, how, and When HR Analytics Can Impact Organisational Performance" (2022). This study presented a chain model wherein HR analytics are enabled by HR technology access, which bolsters Evidence-Based Management and improves the performance of the organization.

HR analytics offers a data-driven framework that allows workforce issues to be solved through data analysis using statistical model-applying tools and procedures. According to a study by H.H.D.P.J. Opatha (2020) in their work "HR Analytics: A Literature Review and New Conceptual Model," this enables managers to optimize human resource management by providing fresh insights for more intelligent decision-making.

The creation of human resources as a separate field in the early 20th century was inspired by Frederick Winslow Taylor (1856–1915). American institutional economist John R. Commons used the term "human resource" in his 1893 book "The Distribution of Wealth." However, the establishment of HR departments to supervise the relationship between employers and employees did not occur until the 20th century [8]. Performance management is an essential part of human resources since it is a continuous communication process between managers and employees to achieve organizational goals and improve employees' personnel skills[9]. This communication method includes setting goals, providing constant feedback, laying out specific expectations, and keeping track of results. Performance management establishes a communication mechanism between a manager and employee that is created over the year to accomplish both organizational and personal goals. Analyze all of the collected data to better understand employee managers, and apply the knowledge gained to close performance gaps. Numerous methods are used to collect this data, including HR analytics. [10][9]

HR processes include the following:
1. Human resource planning, which includes hiring, training, orientation, evaluation, promotion, and layoffs.
2. Benefits administration and employee compensation.
3. The Management of Performance.
4. Employee Relations.

The degree of connection between each of these determines how well these procedures are designed, independent of other factors. This implies that every process is dependent upon every other process. The process begins with human resource planning, and value is added continuously at every stage.

1. Human Resource Planning: People forecasting is generally understood to be the process of HRP. Accurate, but not quite! It also includes the layoff, promotion, and evaluation processes.

2. Administration of benefits and employee remuneration: This process involves determining pay grades, bonuses, perks, and additional benefits. Money is the main motivator in any career, which emphasizes how important this process is Employees who make promises strive for better treatment, bonuses, and pay raises.

3. Performance management: Its objective is to help the business train, motivate, and reward its staff. It also seeks to ensure that the organization's goals are effectively attained. Apart from the employees, the process can be related to a department, product, service, or client procedure; the objective is consistently to enhance or generate value.

4. Employee Relations: Employers find it difficult to retain staff, especially in industries with intense competition. Although individuals join or quit organizations for a variety of reasons, relatively few of them are under our direct control.

METHODOLOGY:
The research technique establishes how the study will be conducted. This includes the procedures you plan to use for observation, statistical analysis, and data gathering. Supporting or validating your data-gathering technique and the primary study findings is the aim of research methodologies.

POWER BI:
Understand the purpose of your HR dashboard. Determine what key metrics and insights you want to track and display. Collect relevant HR data from various sources such as HRIs systems, spreadsheets, performance management tools, surveys, etc. Handle missing values, eliminate duplicates, and standardize formats to clean up the data. Convert the data into a format that Power can use for analysis and visualization. Establish relationships between several data tables in Power BI to create a data model. This step is crucial for building accurate and meaningful visualizations. Design your HR dashboard layout in Power BI. Choose appropriate visualizations such as bar charts, line graphs, pie charts, KPI indicators, etc., based on the metrics you want to showcase. Create visualizations for key HR metrics such as headcount, turnover rates, employee demographics, performance ratings, training effectiveness, etc. Use interactive features like drill-downs, filters, and slicers for deeper analysis. Incorporate analytics into your dashboard, such as trend analysis, year-over-year comparisons, and bench marking against industry standards or internal targets. If applicable, integrate predictive analytics models to forecast trends like future turnover rates or identify potential skill gaps. Include sentiment analysis or employee survey results to gauge employee satisfaction and engagement levels. Test your HR dashboard to ensure data accuracy, functionality, and usability. Solicit feedback from HR professionals or stakeholders for improvements. Publish and share your HR dashboard with relevant stakeholders using Power BI service or integrate it into existing HR portals or systems for wider access. Regularly monitor the dashboard for any changes in HR metrics. Update the dashboard as needed to reflect new data or evolving HR priorities. By following these steps, you can create an effective HR dashboard in Power BI that provides actionable insights for HR decision-making and workforce management.

TABLEAU :

Building an HR analytics dashboard with Tableau can provide valuable insights into various aspects of your organization's workforce. Determine which HR metrics are most important for your organization, such as employee turnover rate, performance ratings, recruitment metrics, etc. Gather relevant data from various sources such as HRIS (Human Resources Information System),

performance management systems, recruitment databases, etc. Ensure data quality by cleaning and preparing it for analysis. This may involve handling missing values, removing duplicates, and formatting data appropriately. Import the cleaned data into Tableau and connect it to create a data source. Plan the layout of your dashboard, including which metrics to display and how to arrange them for easy interpretation. To illustrate your HR information, use Tableau's drag-and-drop interface to create visualizations like pie charts, bar charts, and line graphs. To help consumers better explore the data, consider enhancing the dashboard with interactive elements like drill-down capabilities, filters, and parameters. Calculate additional metrics or apply calculations within Tableau as needed to derive insights from the data. Customize the appearance of your dashboard by choosing appropriate colors, fonts, and layout options to make it visually appealing and easy to understand. Test the dashboard with stakeholders to gather feedback and make any necessary revisions to improve usability and effectiveness. Once finalized, publish the dashboard to Tableau Server or Tableau Online, and share it with relevant stakeholders within your organization. Continuously monitor the performance of your HR analytics dashboard and update it as needed to reflect changes in your organization's workforce or data sources

SQL:

HR analytics using SQL involves a systematic process starting with defining objectives and gathering HR data from databases. After cleaning and preprocessing the data, SQL queries are used for data exploration, analysis (such as performance trends, and turnover factors), and creating visualizations or integrating with visualization tools for effective communication. Optional steps may include modeling for predictive analytics. The final stage includes interpreting insights, preparing reports, and iterating the process for ongoing refinement, all while leveraging SQL for data manipulation and analysis throughout the entire process.

MACHINE LEARNING ALGORITHMS:

K-NEAREST NEIGHBOUR (KNN):

The K-Nearest Neighbors (KNN) algorithm is a simple yet effective supervised machine learning algorithm used for classification and regression tasks. In KNN, an object is classified by a majority vote of its neighbors, with the object being assigned to the class most common among its k nearest neighbors (k being a specified positive integer, typically small)
Steps to implement the K-NN algorithm:

- pre-processing data
- K-NN algorithm fitting to the training set
- Estimating the outcome of the test
- Test the result's correctness (Creation of Confusion matrix).
- displaying the test set's outcome.

LOGISTIC REGRESSION:

Logistic regression is a statistical model used for binary classification tasks, where the outcome variable (dependent variable) is categorical and has only two possible values, such as 0 or 1, Yes or No, and True or False. It's widely used in machine learning and statistics for predicting binary outcomes based on one or more predictor variables (independent variables).
For logistic regression, the sigmoid function is known as an activation function and is described as follows: where,

$$F(x)=1/1+e^{-x}$$

- *e = base of natural logarithms*
- *value = numerical value one wishes to transform*

The following equation represents logistic regression:

$$y = \frac{e^{(b_0 + b_1 X)}}{1 + e^{(b_0 + b_1 X)}}$$

This accuracy score provides insight into how well the logistic regression model performs in predicting outcomes related to HR analytics, such as employee turnover.

RANDOM FOREST :

A 'forest' of decision trees is created by the random forest algorithm. Then, to prevent overfitting and generate more accurate predictions, it merges these several decision trees.

Accuracy= Total Number of Predictions / Number of Correct Predictions

Random Forest can often provide higher accuracy compared to logistic regression, especially when dealing with complex datasets with nonlinear relationships between features and the target variable. However, it's important to interpret the accuracy score in the context of your specific HR analytics objectives and consider other evaluation metrics as well.

STOCHASTIC GRADIENT BOOSTER (SGB):

Stochastic Gradient Boosting can be effectively applied to HR analytics tasks such as predicting employee turnover or attrition.

Procedure:

- Import the required library

- Establishing repeatability with SEED

- Divide the digit dataset into train and test groups after loading it.

- Create a Gradient Boosting classifier instance and apply the model.

- Calculate the accuracy score and forecast the test set.

Organizations may optimize workforce management, save turnover costs, and improve employee satisfaction and retention by utilizing Stochastic Gradient Boosting in HR analytics to inform data-driven decisions.

Exploratory Data Analysis (EDA): Use data visualization tools (Power BI, Tableau) to explore relationships, trends, and patterns in HR data. Identify potential factors influencing organizational performance.

Model Development and Evaluation: Apply machine learning algorithms (SGB, Random Forest, KNN, Logistic Regression) to build predictive models for HR analytics. Evaluate model performance using metrics like accuracy, precision, recall, etc.

Interpretation and Actionable Insights: Interpret model results, identify key drivers of organizational performance, and derive actionable insights to inform HR strategies and decision-making processes. By combining the capabilities of data visualization tools, SQL for data manipulation, and machine learning algorithms for predictive analytics, HR professionals can gain valuable insights into workforce dynamics, employee engagement, talent management, and overall organizational performance
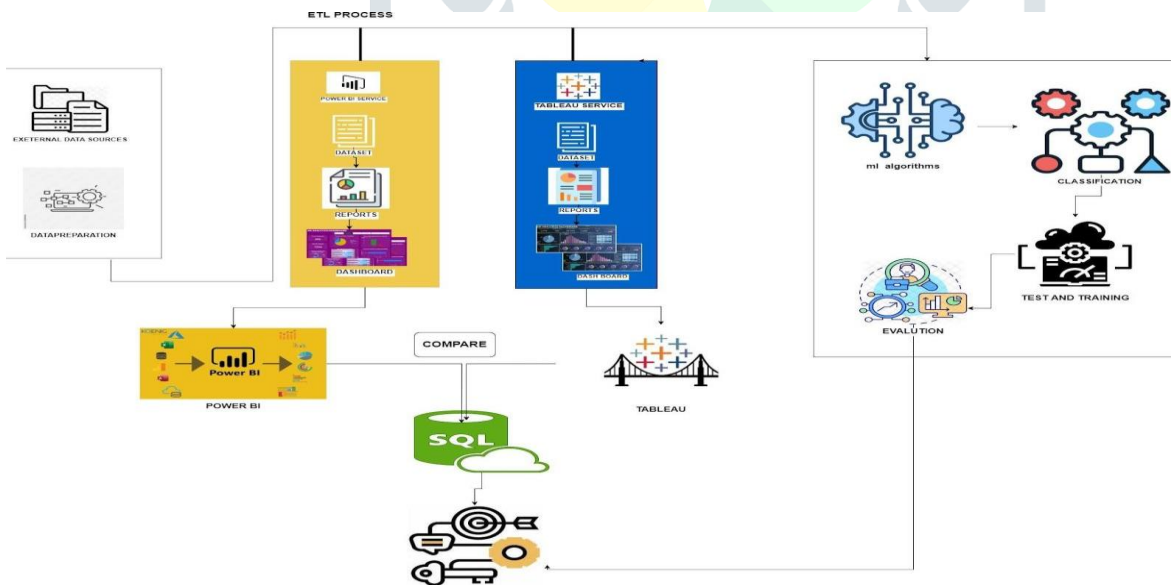

Fig(1):Schematic representation for utilizing Power BI,Tableau and SQL in HR management functionalities

The diagram represents a data processing workflow, specifically one that might be used in data analytics. It outlines a series of steps that are typically involved in extracting insights from data.

1. **ETL Process**: This stands for Extract, Transform, Load. It's the process of extracting data from various sources, transforming it into a format suitable for analysis, and loading it into a data warehouse or database. The diagram shows a symbol for external data sources and a database, indicating the flow of data from its sources into a structured repository.
2. **Power BI / SQL / Tableau**: These are tools used for data analysis and visualization. Power BI is a business analytics service by Microsoft, SQL (Structured Query Language) is a programming language used for managing and manipulating databases, and Tableau is a data visualization tool. The diagram suggests a comparison or integration of these tools for analyzing and visualizing data.

3. **Machine Learning**: This section of the diagram outlines the process of applying machine learning algorithms to the data. It includes steps for classification, which is a type of supervised learning where the algorithm learns from the data input given to it and then uses this learning to classify new observations. There is also a reference to test and training, which are datasets used to train the machine learning model and test its accuracy, respectively.
4. **Evaluation**: This step involves assessing the performance of the machine learning models. It's an essential part of the machine learning process to ensure that the models are making accurate predictions or classifications.
5. **Data Processing and Analysis Tools**: At the bottom of the diagram, there are icons representing various tools and technologies used in data processing and analysis. These include cloud services, databases, and other data-related symbols, indicating the use of these tools in the overall workflow.

**EVALUATION METRICES:**
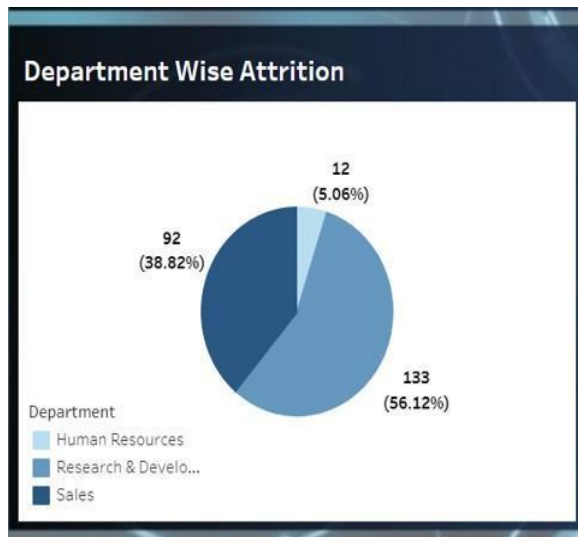
Tableau
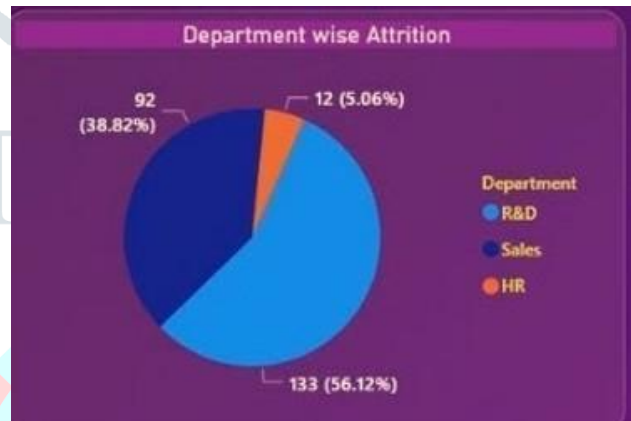
Power BI

Fig(2)(3):Department Wise Attrition

Both diagrams you described are pie charts used to represent employee attrition rates across various departments in a company. However, there are some key differences in the information they convey. Both use pie charts, which are ideal for showing the proportions of a whole. They both focus on the department-wise distribution of employee attrition. The first diagram likely includes data labels specifying the department name and percentage attrition rate for each slice. The second diagram lacks these details and relies solely on color size to represent proportions. The first diagram provides a more detailed understanding of employee attrition, allowing you to pinpoint the exact department with the highest percentage. The second diagram offers a general sense of which departments have higher or lower attrition rates. In essence, the first pie chart offers a more precise analysis, while the second provides a broader visual comparison.
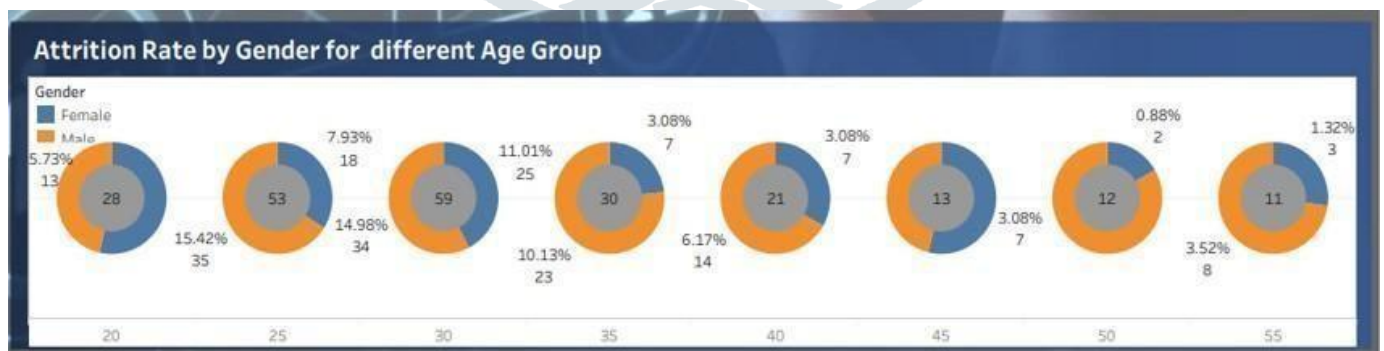
Tableau
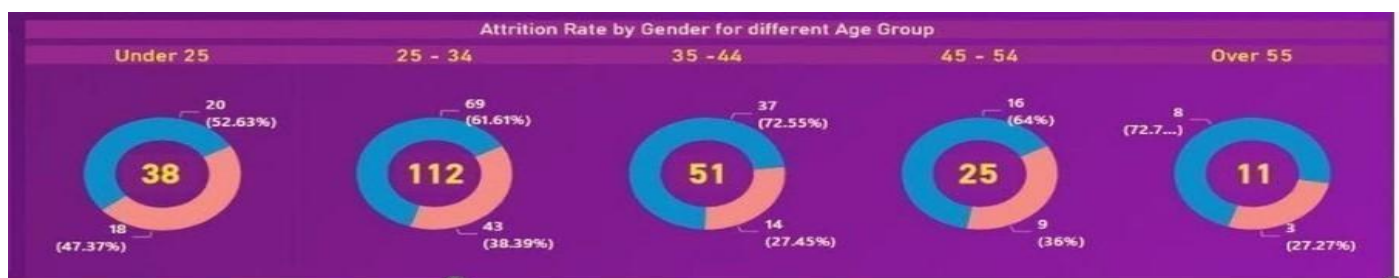
Power BI
Fig(4)(5): Attrition Rate by Gender for different age groups

Both diagrams display percentages. The y-axis in each diagram shows the percentage of a population falling into a specific category. Both use lines or bars to represent data points. The Current Attrition Rates use bars, while the Infertility service uses lines. Each diagram highlights trends over time or across categories. Current Attrition Rates show the difference in Attrition prevalence by sex and age. "Infertility service use" shows how the use of infertility services has changed over time for different age groups. The data itself is vastly different. Current Attrition Rates deal with health issues, whereas "Infertility service use" focuses on demographics and healthcare utilization. The x-axis in each diagram represents a different variable. In "Curren Attrition Rates" it's sex and age, while in "Infertility service use" it's the age group and calendar year. The scales on the y-axis differ. "Curren Attrition Rates" likely go from 0% to a value slightly higher than 10%, whereas "Infertility service use" might range from 0% to 30% or higher. Overall, while both diagrams present percentages and trends, they do so in very different contexts.

Job Satisfaction Rating

Job Role	Job Satisfaction 1	2	3	4	Grand Total
Healthcare Representative	26	19	43	43	131
Human Resources	10	16	13	13	52
Laboratory Technician	56	48	75	80	259
Manager	21	21	27	33	102
Manufacturing Director	26	32	49	38	145
Research Director	15	16	27	22	80
Research Scientist	54	53	90	95	292
Sales Executive	69	54	91	112	326
Sales Representative	12	21	27	23	83
Grand Total	289	280	442	459	1,470

Tableau

job Satisfaction Rating

JobRole	1	2	3	4	Total
Healthcare Representative	26	19	43	43	131
Human Resources	10	16	13	13	52
Laboratory Technician	56	48	75	80	259
Manager	21	21	27	33	102
Manufacturing Director	26	32	49	38	145
Research Director	15	16	27	22	80
Research Scientist	54	53	90	95	292
Sales Executive	69	54	91	112	326
Total	289	280	442	459	1470

Power BI

Fig(6)(7): Job Satisfaction Rating

Both diagrams you described, titled "HR Analytics Dashboard" and "Job Satisfaction Rating", although likely from the same source, present similar data with some key differences: Both focus on job satisfaction within a company, presenting ratings for various roles. They use numerical scores to represent job satisfaction. While their specific formats might differ (dashboard vs. specific rating), they likely use bars or similar elements to show these scores for different job titles. The range of the satisfaction scores differs. The first diagram mentions a scale of 1 to 5, while the second mentions specific scores with decimals (e.g., 4.59). The first diagram offers a broader overview, possibly showing department averages or satisfaction ranges. The second provides more specific details, showcasing individual job title ratings with seemingly higher precision. The specific job titles displayed might differ between the two visualizations. The first diagram might aim to provide a quick high-level comparison across departments, while the second focuses on pinpointing specific job satisfaction leaders and laggards. Overall, both diagrams seem to be part of a larger HR analytics suite, offering different lenses to examine employee satisfaction within a company.

S.No	K-Nearest Neighbors	Random Forest	Logistic Regression	Stochastic Gradient Boosting
1	0.9667	0.9000	0.8667	0.9000
2	0.9668	0.9677	0.8663	0.9867
3	0.9778	0.9333	0.8367	0.9000
4	0.9578	0.9473	0.9000	0.9337

Table 1.Performance matrix

FUTURE SCOPE:

HR analytics is a technique that helps companies create and assess workforce insights, determine how each employee contributes to revenue generation, reduce overall costs, manage risks, and accomplish strategic goals. It's a data analysis method where HR regularly collects employee data, which is then utilized to understand how the company can ensure the organization's performance. To further illustrate how HR contributions support organizational objectives, HR teams evaluate performance against the organization's goals. An organization can easily ascertain its strengths and weaknesses with the use of HR analytics. Given that people are a company's main source of energy, HR Analytics will benefit from an understanding of the workforce's contributions and the use of quantitative metrics. A corporation can easily ascertain the benefits and drawbacks of HR analytics. Given that workers are an organization's primary source of motivation, understanding the contributions made by their staff and applying quantitative measurements can assist a company in identifying its strengths and weaknesses. Utilizing the data, initiatives that advance organizational goals and increase success can be developed.

CONCLUSION:

In conclusion, leveraging a comprehensive approach that integrates HR analytics with tools such as Power BI, Tableau, SQL, and ML algorithms can significantly enhance decision-making within an organization. By harnessing the capabilities of these technologies, HR professionals can gain deep insights into employee performance, engagement, retention, and recruitment processes. Power BI and Tableau offer robust visualization capabilities, allowing stakeholders to easily interpret complex data and identify trends. SQL enables efficient data management and retrieval, crucial for processing large datasets typical in HR analytics. ML algorithms, on the other hand, enable predictive analytics, helping forecast employee attrition, identify high-potential candidates, and personalize employee experiences. This integrated approach not only streamlines HR processes but also enables proactive decision-making, leading to improved workforce management, reduced costs, and ultimately, better business outcomes. As organizations continue to embrace data-driven strategies, the synergy between HR analytics and these advanced tools will play a pivotal role in driving organizational success and competitiveness in the modern business landscape

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