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ANALYSIS OF EMERGING JOB TRENDS: A MID-TERM PREDICTION OVER FIVE YEARS

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Abstract

In 2019, the world experienced a health crisis related to COVID-19. This pandemic had unprecedented, considerable consequences on the global economy. However, countries were compelled to make efforts to absorb the negative effects of this pandemic. The adverse effects of this crisis were notably observed in its influence on the job market. In this research, we showcase the shift in demanded professions post this crisis. To achieve this, our focus is on predicting future technical jobs in the United Kingdom, specifically in the field of information technology. The data utilized in this study is sourced from the 'Glassdoor' platform. To conduct our prediction, we employed the 'Autoregressive Integrated Moving Average' (ARIMA) model. Empirical results confirmed our selection.

Index Terms: ARIMA, Glassdoor, Royaume-Uni, COVID-19.

1. INTRODUCTION

The global health crisis of COVID-19 had economic consequences and will have repercussions on the job market. Companies are compelled to downsize their workforce, while others are shifting their sectors of operation, leading to a decrease in labor demand and triggering a new cycle of jobs. The current global economic context underscores the urgency of adopting a new job framework and implementing effective measures to preserve these jobs. In this study, our aim is to provide new enlightening paths and trends for medium and long-term developments in job types, occupations, and skills. Our

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research will play a significant role for companies and countries in anticipating transformations, facilitating transitions, and supporting workers in career changes or skill advancement.

To conduct our study, we utilize the 'Glassdoor' dataset. The comprehensive dataset at our disposal comprises job descriptions and rankings based on various criteria such as work-life balance, income, culture, and more. These data encompass a variety of industries within the United Kingdom, serving as a valuable resource for conducting a multidimensional sentiment analysis.

Glassdoor generates reports based on data collected from its users, covering topics including work-life balance, compensation, rankings of top workplaces and company cultures, as well as the accuracy of job search information provided by companies. External sources have also leveraged Glassdoor data to estimate the effects of wage trends and variations on company revenues.

In 2015, Tom Lakin [1] conducted the initial Glassdoor study in the United Kingdom, concluding that users regard Glassdoor as a more reliable source of information compared to career guides or official company documents.

Kluemper, D. et al. [2] examined how assessments on professional social networking sites like Glassdoor can be shaped by evaluators' personalities and the organizational context. This study raises inquiries about the objectivity and validity of online assessments.

In 2019, Anderson, K. [3] conducted a detailed examination of employee reviews on Glassdoor, focusing on their tone, content, and their influence on job seekers' perceptions. The study also highlights the factors influencing the composition of reviews on Glassdoor.

Zhu, C. J., and Khalifa, M. [4], studied the impact of Glassdoor reviews on organizational performance. They examined how positive or negative evaluations could influence a company's reputation and affect its performance.

In 2021, Yang, C., & Li, J. J. [5], explored the impact of employee reviews on Glassdoor on a company's product quality. They examined how employee evaluations could influence consumers' perceptions regarding product quality.

In 2022, Kim, H. [6], focused on the role of employee reviews on Glassdoor in employee retention. They examined how these evaluations influence employee engagement and their willingness to remain within the organization.

Dans this study, our focus lies particularly on columns related to the evaluation date, company name, evaluator status, and the evaluations themselves. Our primary goal is to rank companies based on employee-provided evaluations, which range from "1" to "5", representing a scale from the most negative to the most positive evaluations. Subsequently, we will choose a specific company from these rankings and compute the sum of ratings given by employees of that company. Using these evaluations, we aim to

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make predictions regarding the company's trajectory both before and after the COVID-19 pandemic.

It's important to note that the database we're using encompasses information from 2008 to 2021, and our intention is to make predictions from 2021 through 2026.

2. RELATED WORK

2.1 Job Satisfaction

The job market is constantly evolving worldwide. By 2030, the labor market is set to undergo significant changes. Despite the easing of the health crisis in many countries, employment is experiencing a global slowdown: 'The number of hours worked worldwide has seen a decline in the first quarter of 2022' [7]. The most sought-after and promising jobs for the future are those related to Information and Communication Technologies (ICT), healthcare, and renewable energies. However, it's important to note that trends can vary based on countries and regions [8].

Job satisfaction is defined as an individual's attitude toward their work. It depends on the perception of certain aspects of the job, the implicit or explicit standard of the employee's values and expectations, and their pleasant or positive emotional state. Sociological research has defined job satisfaction as a dimension or emotional state resulting from one's appreciation of their work. Indeed, it's perceived as 'an affective reaction' constructed from the comparison between actual performance and the expected performance by the employee, and it has been observed to be linked to the volume of positive outcomes achieved by the individual [9].

There are several factors that influence job satisfaction, such as working conditions, management style, compensation, recognition, autonomy, relationships with colleagues, and more. Job satisfaction has significant consequences for both the employee and the company, impacting involvement, performance, absenteeism, turnover, etc. For instance, in a study aiming to examine the relationship between human resource practices and job satisfaction in the Information and Communication Technologies (ICT) industry in Turkey, the authors found that investing in HR practices encourages employees to be more proactive in devising measures and means to perform their work, thereby enhancing their job satisfaction. This consequently leads to desirable and favorable organizational outcomes [10].

Regarding the influence of shift work, work environment, and job stress on employee satisfaction, the study [11], conducted with 120 employees through an online survey, indicates that job stress has a significant negative effect on satisfaction, while the work environment has a significant positive effect. Alternative work schedules also have a considerable impact on employee satisfaction with their job. Therefore, human resource management that considers the alignment of employees' skills with their field of work to reduce employee turnover is likely to create a conducive work environment. Additionally, maintaining work motivation, employee engagement, and a positive work climate, which exert significant influence, is essential [12].

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In [13], the authors examined the mediating role of psychological need satisfaction for the effects of job demands and resources on psychological distress and work-family conflict, simultaneously at both the individual and unit levels of work. The results supported the idea that the effects of the work environment on the outcomes considered in this study were mediated by psychological need satisfaction at both individual and unit levels of work. They demonstrated that these associations were driven by overall perceptions of the work environment and overall satisfaction of needs.

2.2 ARIMA (Autoregressive Integrated Moving Average)

To model time series data, traditional statistical models like moving averages, exponential smoothing, and ARIMA can be used. These models are linear as they constrain future values to be linear functions of past data. Over the past decades, researchers [14][15][16] have largely focused on linear models due to their proven simplicity in terms of understanding and application. These models offer a practical and understandable approach to analyzing and forecasting time series. However, it's worth noting that in certain cases, non-linear models may be necessary to capture more complex relationships and non-linear trends in time series data.

ARIMA is a widely used model for time series forecasting. It combines the autoregressive (AR) and moving average (MA) components. The ARIMA model is suitable for stationary time series, where the mean and variance of the time series remain constant over time. The three key parameters of ARIMA are p, d, and q:

p represents the order of the AR component (Auto Regressive) and captures the linear relationship between current observations and past observations.

d represents the degree of differencing required to make the time series stationary.

q represents the order of the MA component (Moving Average) and captures the linear relationship between current observations and past residual errors.

Time series forecasting models are primarily employed for predicting demand. Under an autoregressive moving average assumption, Kurawarwala and Matsuo [17] computed the seasonal variation in demand using historical data and validated the models by examining forecast performances. Their study aimed to gauge the effectiveness of forecasting models by comparing forecasts against actual data. This approach allows for the evaluation of model accuracy and parameter adjustments, if necessary, to enhance future demand predictions.

Abu Bakar and Rosbi [18] examined the reliability of the Box-Jenkins statistical method in forecasting stock price performance within the oil and gas sector of the Malaysian Stock Exchange. They found that Gas Malaysia Berhad's performance could be accurately forecasted using the Autoregressive Integrated Moving Average (ARIMA) model with parameters (5, 1, 5). Similarly in Malaysia, Balli and Elsamadisy [19] compared linear methods and observed that the seasonal ARIMA model provides better short-term forecast estimates in the state of Qatar.

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The significance of forecasting methodology in the stock market is also outlined by Stevenson [20], who scrutinizes issues associated with applying the forecasting method. The findings underscore the limitations of employing the conventional approach to identify the best-specified ARIMA model within the sample when the analysis aims to provide forecasts. The results demonstrate that ARIMA models can be useful in anticipating general market trends.

While Jadevicius and Huston's study [21] suggests that ARIMA is a useful technique for assessing overall price variations in the market, governments and central banks can employ the ARIMA modeling approach to forecast national inflation in real estate prices.

William W.S. Wei and all [23] [24], have dealt extensively with statistical models in the time domain and methods of time series analysis, highlighting their usefulness in a variety of applications. Their work covers a wide range of topics, including fundamental concepts of temporal modeling, stationary and non-stationary models, seasonal and non-seasonal models, intervention models and outlier models. In addition, they explore transfer function models, regression models for time series, vector time series models, and present practical applications of these various approaches. This comprehensive study offers readers a thorough understanding of the tools available for time series analysis and forecasting in a practical context.

Brockwell, P. J. and all [24] contributors have presented fundamental ideas on time series analysis and stochastic processes. They highlighted essential concepts such as stationarity, as well as sample auto covariance and autocorrelation functions, which are of particular importance in this field. Emphasis has been placed on certain standard techniques used to estimate and eliminate the trend as well as the seasonality (with a known period) of an observed time series. Their contribution provides a sound basis for understanding the fundamentals of time series analysis and methods for decomposing and modeling these series for more accurate interpretation.

3. RESEARCH METHODOLOGY

Time series are a powerful tool for data analysis across various domains, including the realm of computer companies. In this article, we delve into the use of time series to study the evolution and ranking of computer companies. We examine how chronological data can be collected, processed, and analyzed to identify trends, cycles, and fluctuations in the field of computing. By employing statistical methods and time series models like ARIMA, we present case studies on the evolution of computer companies over time.

3.1 Methodology

In the IT sector, the demand for services evolves rapidly based on technological needs and market trends. In this study, we focus on a leading global IT company to analyze the services sought within the organization. Our objective is to use employee reviews as an indicator to understand the most requested services within the company and to analyze whether employee evaluations have been impacted by the COVID-19 pandemic.

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Additionally, we conduct predictions based on these evaluations to identify the company's trajectory for the next five years, from 2021 to 2026.

3.2 Dataset

We used a dataset from Glassdoor [25], which includes job descriptions and employee reviews for various companies, including the company under our study. The data covers the period from 2008 to 2021. It includes information such as the evaluation date, job title, job location, evaluator status, and evaluations based on different criteria. We extracted specific evaluations related to IBM, focusing on ratings on a scale of 1 to 5.

The data is divided into two sets, one for training and the other for testing. The training set covers years before 2021, while the test set includes years from 2021 to 2026.

3.3 Exploratory Data Analysis

Before applying prediction models, we conducted an exploratory data analysis. We examined the distribution of evaluations and identified the most frequent ratings among the employees of the company under study.

3.4 Data Preparation

We prepared the data by filtering only the employee reviews from this company and selecting the evaluation column on a scale from 1 to 5. We also handled any missing or outlier values, if present.

3.5 Forecasting with ARIMA

We utilized the ARIMA (Auto Regressive Integrated Moving Average) model to model the employee evaluation data at IBM. We made forecasts for the next five years, from 2021 to 2026. This allowed us to grasp temporal trends and predict future employee evaluations within the company in a post-pandemic context.

3.6 Impact Analysis of the COVID-19 Pandemic

We compared employee evaluations before and after the COVID-19 pandemic period to understand if the health crisis had a significant impact on employee appraisals within the company under our study.

4. RESULTS

Figures 1 and 2 compile the most requested services within this company, ranked based on the ratings given by employees. These services typically garner the most interest within the company

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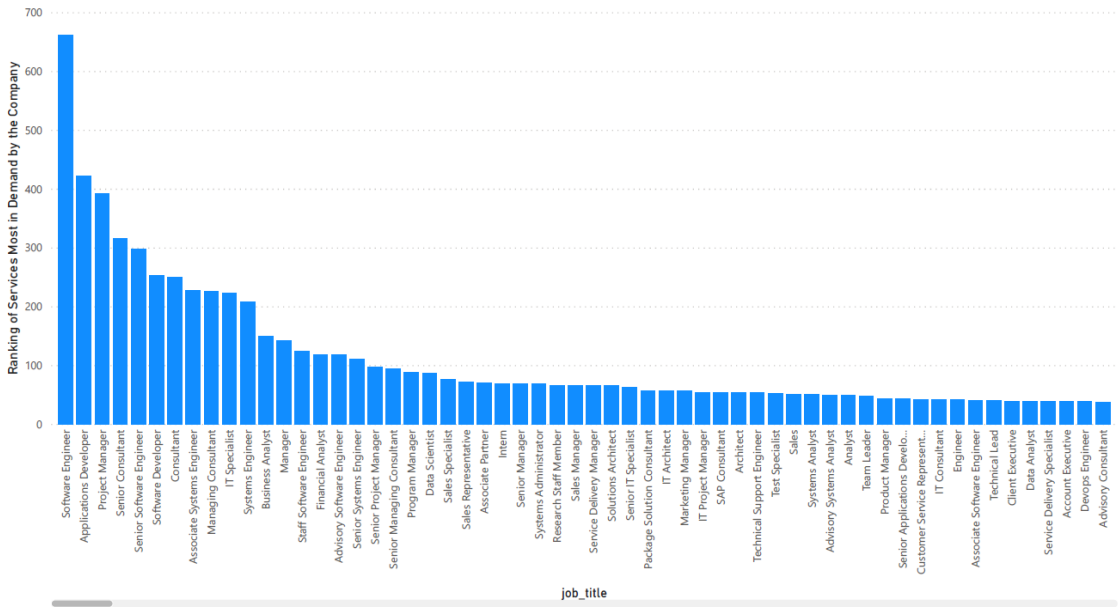

Figure 1: Ranking of the Most-Requested Services by IBM Employees Ratings

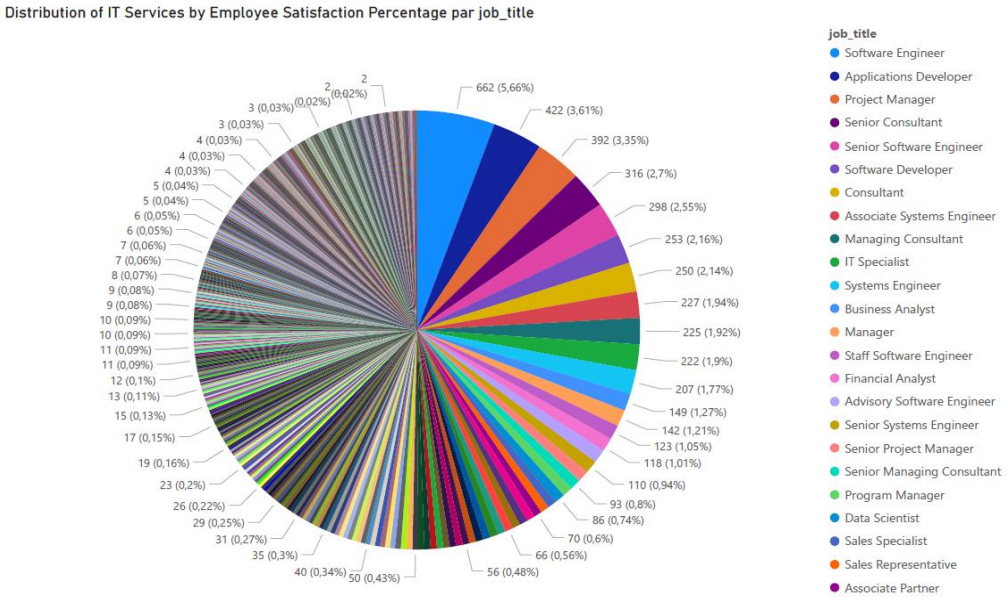

Figure 2: Distribution of IT Services Based on Employee Satisfaction Percentage

After conducting our analysis, we identified the top ten most requested services within IBM in the field of IT. These services were selected based on their relevance and significance within the organization.

Table 1 displays the top ten requested positions along with the employee-rated evaluation score for each position and the number of participating employees. It's noteworthy that

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the employee evaluation score is standardized at a value of 4, indicating a positive evaluation from employees for all listed positions.

Furthermore, Figure 3 supplements this information by visually illustrating the ratings assigned to each position. This in-depth study will help us better understand the needs and preferences of employees regarding these services.

Table 1: Employee Ratings and Number of Votes

Requested Service	Employee Evaluation Rating	Number of Employees Voted
Software Engineer	4	657
Applications Developer	4	422
Project Manager	4	392
Senior Consultant	4	315
Senior Software Engineer	4	297
Software Developer	4	253
Consultant	4	248
Associate Systems Engineer	4	226
IT Specialist	4	221
Managing Consultant	4	219

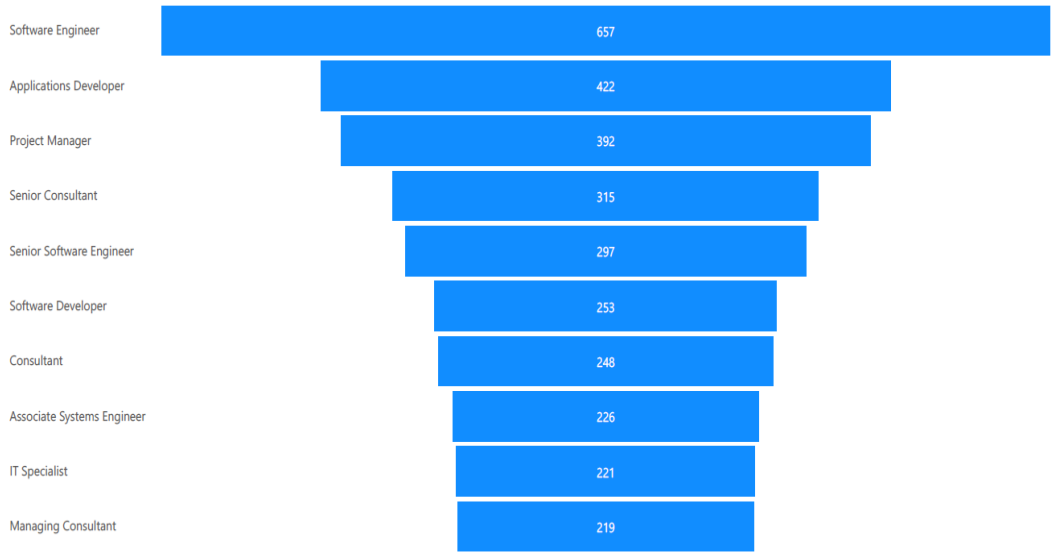

Figure 3: Top Ten Sought-After Positions in the IT Field at IBM

In the provided data, the top ten services most requested by the company have been evaluated and voted on by employees. Table 1 and Figure 3 showcase that software engineer's top the list with an evaluation rating of 4 and an impressive 657 votes. This attests to their high demand and significance within the company. Following closely, application developers rank second, also well-rated with a score of 4 and 422 votes.

This trend highlights the company's emphasis on software development and application creation to address technological needs. Project managers also stand out with a rating of 4 and 392 votes, underlining the importance of project management for the company's initiatives. Senior consultants, senior software engineers, software developers,

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consultants, associate systems engineers, IT specialists, and management consultants are also among the most requested and highly rated services. These findings suggest that the company values technical expertise, project management, and strategic counsel to ensure its success.

After conducting an in-depth analysis of the top ten services requested by IBM in the field of IT, our next step is to utilize this data to make predictions regarding the company's evolution, both before and after the COVID-19 pandemic.

After loading the data, we divided it into training and testing sets. Figure 4 illustrates that the training set covers years prior to 2022, while Figure 5 shows that the test set comprises the years from 2021 to 2026.

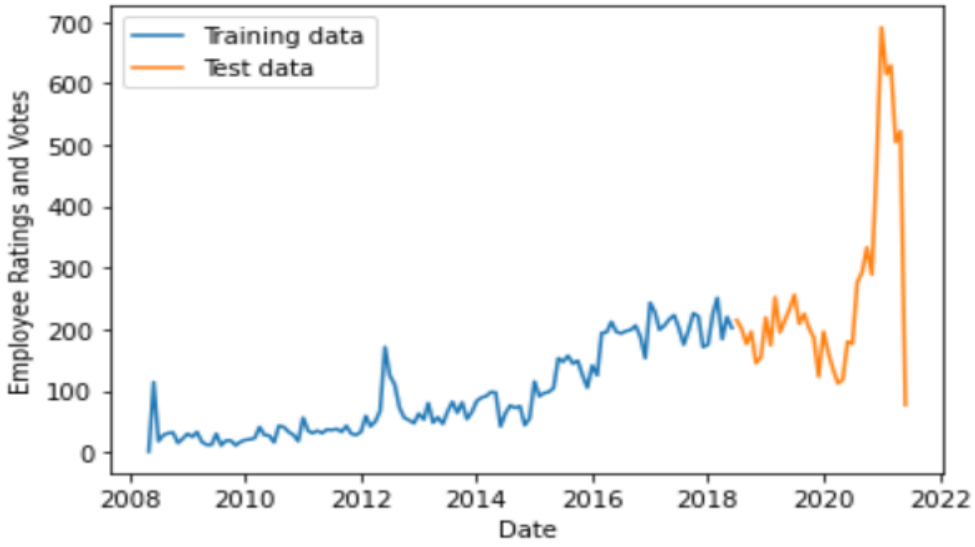

Figure 4: Division of Data into Training and Testing Sets

The provided data represents employee evaluation ratings at IBM from 2008 to 2021. Analyzing this data reveals various trends and fluctuations.

During the period from 2008 to 2012, the evaluations display a degree of volatility, showing periods of high and low ratings. This could be attributed to various factors such as organizational changes, internal policy adjustments, or economic fluctuations that influenced employee satisfaction.

From 2012 onwards, there is an upward trend in evaluations, with some regular seasonal variations. This increase can be attributed to improved organizational stability, growth opportunities, or enhancements in working conditions, which have led to higher employee satisfaction.

Between 2015 and 2017, the evaluations appear to stabilize at relatively high levels. This period of stability could be the result of measures taken by the company to maintain a positive work environment or the implementation of employee recognition programs.

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Starting from 2020, we observe a noticeable decline in evaluations. This decrease could be directly linked to the emergence of the COVID-19 pandemic and the confinement measures implemented in many countries. The pandemic brought significant changes in the workplace, such as transitioning to remote work, economic uncertainty, and deteriorating working conditions. These factors might have negatively impacted employee satisfaction and productivity, which is reflected in the evaluations recorded during this period.

However, starting from the second half of 2020 and throughout 2021, the evaluations show a slight improvement, although they remain below the levels observed before the pandemic. This could be attributed to companies gradually adapting to new work modes, implementing support measures for employees, as well as the hope generated by progress in combating the pandemic, such as the deployment of vaccines.

Also worth noting is the significant drop in evaluations for the months of June and July 2021, as mentioned earlier, which could also be pandemic-related. These months coincide with a period when many countries experienced a resurgence in COVID-19 cases or implemented new restrictive measures, potentially negatively impacting employee morale.

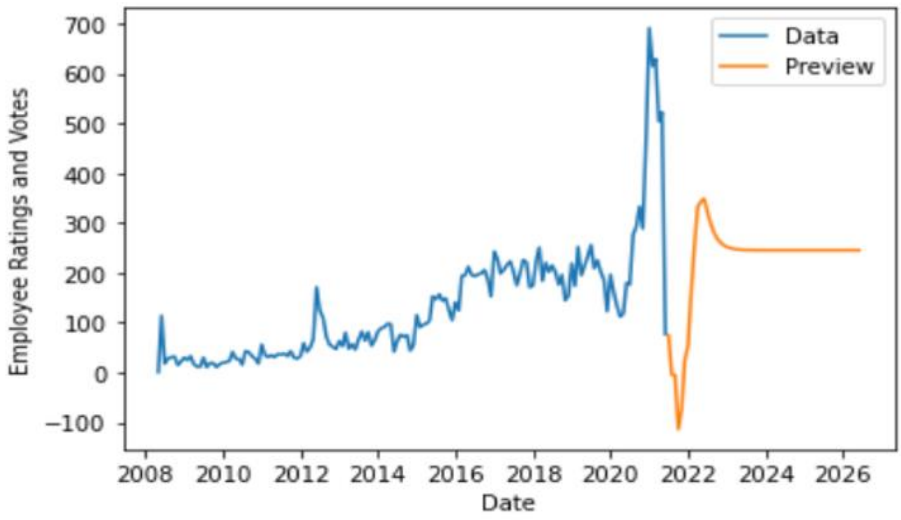

Figure 5: Prediction for the years 2021 to 2026

Using the ARIMA algorithm for predicting employee evaluations from 2021 to 2026 indicated a certain stability, with relatively minor fluctuations. This trend may suggest a period of consolidation following the major disruptions caused by the COVID-19 pandemic.

It's a plausible explanation. The improvement in the health situation, coupled with vaccination and preventive measures, surely aided companies in regaining stability. This could have contributed to restoring employees' confidence and stabilizing their performances.

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Furthermore, organizations could have implemented human resource management policies and practices more suited to the post-pandemic situation, such as mental health support initiatives, flexible work programs, and measures aimed at boosting employee engagement. These efforts may have helped create a more favorable work environment and maintain employee motivation and satisfaction.

It's important to note that the period from 2021 to 2026 could also be marked by structural adjustments within the company. For instance, organizational changes like mergers, acquisitions, or internal reorganizations might impact employee evaluations. These adjustments can lead to periods of transition and adaptation, which could account for some of the fluctuations observed in the evaluations.

5. DISCUSSION

In this discussion, we can observe a convergence between the most demanded services by IBM and the evolution of the company before and after the COVID-19 pandemic.

Before the pandemic, IBM was already highlighting the importance of software engineers, application developers, and project managers, who held the top three positions among the most demanded and best-rated services. These results suggest that the company already valued technical skills and project management to ensure its success. The period of stable evaluations between 2015 and 2017 might also indicate that the company had implemented employee-friendly policies, such as recognition programs, contributing to maintaining employee satisfaction.

However, with the onset of the pandemic in 2020, a significant decrease in evaluations was observed, directly linked to major changes in the work environment. The shift to remote work, economic uncertainty, and deteriorating working conditions negatively impacted employee satisfaction and productivity, reflected in the recorded evaluations during this period. Nevertheless, the latter half of 2020 and the year 2021 showed a slight improvement in evaluations, albeit at levels lower than those before the pandemic. This improvement can be attributed to companies gradually adapting to new modes of work and implementing measures to support employees, such as remote work and mental health support initiatives.

It's interesting to note that even after the disruptive period caused by the pandemic, the most demanded services at IBM haven't changed much. Software engineers, application developers, and project managers still remain at the top of the list, suggesting that these technical and management skills remain crucial for the company.

Analyzing the employee evaluation trends post-pandemic, with relative stability and minimal fluctuations, can be seen as a consolidation period for the company following the major disruptions caused by COVID-19. This stability could be attributed to several factors, including the improvement in health conditions due to vaccination and preventive measures, allowing businesses to regain some sense of normalcy.

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It's also highlighted in the discussion that the period from 2021 to 2026 might witness structural adjustments within the company, like mergers, acquisitions, or internal reorganizations, which could impact employee evaluations. Thus, it's crucial for the company to remain attentive to the evolving needs of its employees and continue adopting adaptable management strategies to sustain employee satisfaction and performance over time.

In conclusion, the increasing demand for technical skills like software engineers and application developers, along with project management, was observed both before and after the COVID-19 pandemic. The pandemic significantly impacted employee evaluations, yet the company managed to adapt gradually and consolidate its operations. This evolution highlights the ongoing importance of these services in ensuring the company's success and underscores the need to adapt to changes in the workplace to sustain employee satisfaction and engagement.

6. CONCLUSION

In conclusion, this study focused on analyzing employee reviews on the Glassdoor platform, with a specific emphasis on the IT sector in the United Kingdom. Leveraging a comprehensive dataset encompassing job descriptions and rankings based on various criteria like work-life balance, compensation, and company culture, we conducted a multidimensional analysis of sentiments. This analysis aimed to evaluate employees' perceptions regarding their respective companies.

During this study, we also reviewed prior research concerning the impact of Glassdoor reviews, encompassing factors like company reputation, organizational performance, product quality, and employee retention. These studies highlight the increasing significance of online employee feedback and its influence across various facets of business management. Our main objective was to rank companies based on employee-provided ratings and select a specific company to make predictions regarding its evolution, both before and after the COVID-19 pandemic. Using ARIMA models, we were able to anticipate future trends and variations based on data available up until 2021. These predictions aim to provide valuable insights to decision-makers, aiding in a better understanding of labor market dynamics within the IT sector and guiding corporate strategies.

It's important to note that our database spans from 2008 to 2021, and our forecasts extend from 2021 to 2026. This gives us a five-year forward-looking perspective to better understand the challenges and opportunities awaiting companies in the field of information technology. In summary, this study has highlighted the growing importance of online employee reviews and their impact on businesses. The results obtained provide insightful perspectives for human resource management and the development of corporate strategies. We hope that these predictions will contribute to a better understanding of the evolution of the job market in the IT sector and assist companies in making informed decisions to ensure their future success.

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