# Evolution of Job Market Trends: Analyzing the Past 10 Years

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*Abstract*—**The job market has undergone significant changes over the last decade due to shifts in the economy, technology, and workforce dynamics. Automation, remote work, and the rise of freelance employment have altered labor demands, creating a need for specialized skills and flexible work arrangements. This project analyzes the factors driving these changes, with a focus on the impact of macroeconomic trends, technological advancements, and demographic shifts across industries such as technology, finance, law, medicine, sports, entertainment, and hospitality. Using a data-driven approach, we examine patterns in employment growth, skill demand, and salary structures, while also forecasting future trends. The findings are presented through interactive dashboards, providing actionable insights for job seekers, educators, and policymakers. Ultimately, this study highlights the evolving nature of work and offers recommendations to help stakeholders navigate a dynamic job market.**

*Index Terms*—*Job Market Trends, Workforce Dynamics, Technological Advancements, Economic Shifts, Employment Growth, Industry Analysis, Data Visualization, Agile Methodology, Workforce Preferences.*

## I. INTRODUCTION

THE U.S. labor market has undergone significant transformations over the past decade, driven by economic, technological, and social factors. These shifts have redefined traditional concepts of employment and influenced career choices at both individual and industry levels. The rise of automation, artificial intelligence, remote work, and the gig economy has created an increasingly dynamic job market marked by constant innovation and flux.

One of the most notable changes is the widespread adoption of advanced technologies, which has restructured the nature of work. Automation has streamlined many processes, making some jobs obsolete while creating new roles requiring specialized technical skills. At the same time, remote work has reshaped workplace culture, offering greater flexibility but also presenting challenges in maintaining productivity and employee engagement.

Economic factors, including cycles of recession and recovery, have also played a pivotal role in shaping job opportunities across sectors. Meanwhile, shifting workforce demographics—particularly among younger generations—emphasize work-life balance, career development, and meaningful work, driving the rapid growth of the freelance economy as more individuals prioritize autonomy and flexibility over traditional employment models.

This study investigates these evolving trends in the U.S. job market, focusing on key sectors such as technology, finance, healthcare, entertainment, law, sports, and hospitality. By analyzing job growth, changing skill demands, and salary trends, the research aims to identify the factors driving these developments and their implications for the future workforce.

The findings are valuable for multiple stakeholders. For job seekers, the study provides guidance on aligning their skills with labor market needs. For policymakers, it highlights critical areas for intervention to support workforce development and economic growth. For industries, it offers insights on adapting to the rapidly changing labor landscape.

Using a systematic, data-driven approach, this project collects and analyzes data from multiple sources through an agile methodology. Interactive dashboards will visualize the findings, providing a comprehensive analysis of historical trends and future forecasts. These insights will help stakeholders navigate the complexities of an evolving job market.

In conclusion, the study underscores the importance of adaptability in a fast-changing world. As industries continue to evolve with technological advancements and shifting workforce preferences, understanding job market dynamics is crucial for individuals, organizations, and governments. By bridging the gap between past trends and future projections, this research contributes to the growing body of literature on employment trends, enabling stakeholders to better prepare for the demands of an increasingly dynamic labor market.

## II. OBJECTIVE

The general goal of the given project is to identify the main trends and influencing factors that have been driving changes in the US labor market within the last ten years, paying special attention to economic changes, technological advances, and shifting workforce preferences. It seeks to achieve the following:

- Outline the pattern of growth in employment in the technology, finance, medicine, entertainment, law, sports, and hospitality sectors.
- Examine how automation, remote work, and demographic changes influence employment opportunities and labor relations.
- Analyze the change in skill demand, job roles, and salary structure to give insights into current and emerging trends.
- Create data-driven insights into the future of the job market to drive better decision-making by job seekers, educators, and policymakers.

- Visualize findings by an interactive dashboard to enhance accessibility, providing actionable recommendations.

## III. SCOPE

This project encompasses a comprehensive analysis of the U.S. job market, focusing on the following aspects:

- **Time frame**: The study examines job market trends over the past decade, providing a historical perspective on changes and their implications for the present and future.
- **Industries**: Key industries under analysis include technology, finance, law, medicine, sports, entertainment, and hospitality, chosen to capture the diversity and dynamism of the U.S. economy.
- **Factors**: It considers economic conditions, technological progress, and shifting demographics. Specific factors include automation, the rise of remote work, the growth of the freelance economy, and changes in workforce preferences.
- **Methodology**: The project follows an agile methodology, consisting of data collection, pre-processing, analysis, and visualization, ensuring flexibility and efficiency while uncovering patterns and trends.
- **Deliverables**: The deliverables include an analysis report and an interactive dashboard providing insights into employment growth, skills demand, and salary trends, aiding decision-making for job seekers, industries, and policymakers.
- **Future Implications**: The study goes beyond historical analysis to explore potential future developments in the job market, offering a forward-looking perspective to navigate evolving dynamics.

This scope ensures a focused yet comprehensive approach, enabling the project to generate meaningful insights into the ever-changing landscape of employment in the United States.

## IV. METHODOLOGY

To analyze the evolution of the job market in US over the past decade, we have adopted a structured agile methodology. The methodology is appropriately segmented to cover different aspects of the study in successive steps and to ensure that the study is systematic, data-driven, and iterative. These are summarized below:

1) **Data Collection**
   - *Sources*: Bureau of Labor Statistics data, industry reports, research publications, and online job marketplaces. These sources give a reliable and various dataset that ranges from employment statistics, growth rates in industries, salary trends, and demands in skills.
   - *Categories*: Data ranges over multiple industries such as technology, finance, medicine, entertainment, sports, law, and hospitality to make the overview wide and detailed on the job market.
   - *Temporal Coverage*: Data is sourced from the past decade and used to identify trends and transformations in the job market over time.

2) **Data Preprocessing**
   - *Cleaning*: The various data collected are cleaned from missing values, inconsistencies, and outliers. This cleansed dataset will ensure precision and reliability in the analysis being done.
   - *Integration*: Combine data from different sources and integrate it into one dataset; this allows for seamless and smooth analysis of cross-industry trends and relationships. Refer Figure [1].
   - *Standardization*: Standardization of metrics and terminologies is done to maintain uniformity across datasets for meaningful comparisons.

3) **Exploratory Data Analysis**
   - *Trend Identification*: EDA techniques are applied to uncover patterns and trends in employment growth, industry demand, and salary structures.
   - *Anomaly Detection*: Unusual patterns, such as abrupt changes in employment or skill demand, are identified for further investigation.
   - *Visual Analysis*: Initial visualizations are created to summarize findings and refine the scope of subsequent analysis.

4) **Data Analysis**
   - *Statistical Techniques*: Statistical methods are used to test relationships among the variables; for example, how changes in technology relate to job availability.
   - *Machine Learning Models*: Various predictive models are developed which can forecast future employment trends, skill demands, and salary trajectories of workers using historical data.
   - *Cross-Industry Comparisons*: Comparison across industries is done to identify sector-specific dynamics and trends.

5) **Visualization**
   - *Interactive Dashboards*: The findings will be depicted in an easy-to-view format via an interactive dashboard. Users can review data based on industry, time, and main trends with the use of this tool.
   - *Info-graphics*: Summary info-graphics will be produced, highlighting main insights such as the fastest-growing industries, emerging skills, and changing salary distributions.

6) **Validation**
   - *Cross-Verification*: Results are compared with literature that already exists, among others, through industry reports and expert opinions.
   - *Iterative Refinement*: Through feedback loops, the insights are reviewed and refined in respect to relevance and accuracy.

7) **Forecasting**
   - *Predictive Analytics*: Utilizes machine learning and statistical modeling toward the forecasting of future employment trends, demands of a particular skill, and resultant salary structures.
   - *Scenario Analysis*: Simulating alternative economic

and technological scenarios to understand how that may affect the job market.

8) **Final Deliverables**

- *Report*: A comprehensive report summarizing the findings, methodology used, and implications to relevant stakeholders.
- *Dashboard*:It delivers an interactive dashboard through which one can explore trends and insights easily.

**Agile Approach**

Throughout the project, an agile methodology is followed in which tasks are divided into sprints. This is an iterative process that keeps on improving and changing at every step according to the needs, feedback, and issues arising during the process. Each sprint focuses on a specific phase of the project, thus ensuring progress toward the final objectives.

Consequently, this strong methodological approach means that the job market analysis of the US has a comprehensive nature with valid insights and recommendations for how to overcome its dynamic changes.

## V. POTENTIAL LIMITATIONS

- *Data Source Limitation:* The employment data is based on a sample of the population rather than a full census. This introduces the potential for **sampling bias**, where certain groups (e.g., part-time workers, gig economy workers, or people in rural areas) may be underrepresented. As a result, the data may not fully reflect the true employment conditions for all demographic groups or regions. This limitation affects the accuracy and generalizability of the analysis, as the sample may not adequately represent specific subgroups, leading to potentially biased or incomplete insights.
- *Visualization Limitation:* While visualizations are designed to simplify complex data, they can sometimes lead to **over-simplification**, which may obscure important details. For instance, using aggregate figures may mask significant regional or demographic variations. Additionally, the choice of chart types may not be the most appropriate for certain types of data, leading to a loss of key nuances.

## VI. DATA COLLECTION

For this project, data is collected from the Data USA website, which offers a wide range of datasets about the United States. The website pulls data from trusted government sources like the U.S. Census Bureau, Bureau of Economic Analysis, and other federal, state, and local agencies. It provides detailed information on various topics, including demographics, economics, education, healthcare, and employment. The data is considered highly accurate since it comes directly from official government records and is regularly updated. Users can explore interactive dashboards to select specific datasets based on factors such as geographic regions, industries, or particular variables. Once the desired data is identified, it can be downloaded in formats such as CSV or Excel for further analysis. This allows for efficient extraction and examination of trends in areas such as population growth, economic development, and social changes across different parts of the U.S. economy [1].

## VII. DATA PROCESSING

For this project, we downloaded various datasets from the Data USA website in CSV format, focusing on sectors such as Healthcare and Education, Professional, Scientific and Management, and Administrative and Waste Management Services, Public Administration, and Manufacturing. In addition to sector data, we delved deeper into features like race, wage, and sex to understand how these factors impact each sector. After downloading the individual files, we used Python to combine them into a single unified dataset. The data cleaning process was performed in Power BI, where we performed several key steps. First, we replaced the header row with the first row of data to ensure correct column names. We then handled missing values by replacing null entries with the median values of their respective columns. Next, we ensured that each column had the correct data type assigned, such as numeric, date, or text, for accurate analysis. Lastly, we unpivoted the date columns to make the data more suitable for time-series analysis. After cleaning and transforming the data, we used it as the main source for our dashboard, allowing us to create insights and visualizations based on the selected sectors and features such as race, wage, and sex.

```python
import pandas as pd
import glob

def append_csv_files(output_file_path,
    input_pattern):
    try:
        all_file = glob.glob(input_pattern)

        dataframes = []

        # Load Source data files
        for file in all_files:
            df = pd.read_csv(file)
            dataframes.append(df)

        # Concatenate into a single output
            file
        big_dataframe = pd.concat(dataframes,
            ignore_index=True)
        big_dataframe.to_csv(output_file_path,
            index=False)

        print(f"Successfully append
            {len(all_files)} CSV file into
            {output_file_path}")

    except Exception as e:
        print(f"An Error occurred: {e}")

output_file_path = 'Employment_Rates.csv'
input_pattern = 'Employment/*.csv'
append_csv_files(output_file_path,
    input_pattern)
```

Listing 1. A Python script designed to concatenate multiple source files into a single output file.

```python
import pandas as pd

# Identify key industry sectors to focus on
sectors = ['Manufacturing',
           'Finance & Insurance, and Real
               Estate, Rental & Leasing',
           'Public Administration',
           'Educational Services, Health
               Care & Social Assistance',
           'Professional, Scientific &
               Management, and
               Administrative & Waste
               Management Services'
           ]

# Load data from the CSV file
df  = pd.read_csv('Wages/Yearly Wage
    Ranking.csv')

# Filter data for predefined industry sectors
    only
df = df[df[Industry Sector].isin(sectors)]
df.to_csv('Wages.csv', index=False)

print(df.dtypes)
print(len(df))
```

Listing 2.   A Python script that filter a DataFrame into predefined industry sectors.

## VIII. EXPECTED OUTCOME

1) **Understanding the Problem Domain**
   - *Key Insight:*The need to understand the context and purpose of the data visualization project became clear. Defining the problem statement clearly helped align the team's efforts with the project's objectives.
   - *Challenge:*Interpreting the nuances in the job market data required understanding complex relationships between employment trends, economic factors, and technological advancements through extra research and domain expertise..

2) **Data Management and Processing**
   - *Key Insight:* The quality of visualization is only as good as the quality of the data.Preprocessing steps, including cleaning, standardization, and integration, took longer than expected but were important for accurate results.
   - *Challenge:*Irregular formats and missing values in data from multiple sources further stressed the need for stringent data preparation practices. Improvement: Automation of cleaning could save more time in future projects.

3) **Tool Proficiency**
   - *Key Insight:* Advanced visualization tools and libraries greatly enhanced the clarity and impact of the final deliverables.
   - *Challenge:*There was a learning curve associated with mastering new tools and techniques, particularly when integrating interactive features like dashboards.

- *Improvement:*Early training on visualization tools and iterative prototyping can streamline the development process.

4) **Effective Visualization Design**
   - *Key Insight:* The correct visualization techniques have to be selected in order to effectively communicate complex information. Interactive dashboards proved invaluable in enabling the stakeholders to explore data dynamically.
   - *Challenge:*Ensuring that the visualizations were both intuitive and comprehensive, with a balance between simplicity and depth, took several iterations.Few tools and techniques, particularly when integrating interactive features like dashboards.
   - *Improvement:*Engaging users early in the design process can help refine visualizations and make them more impactful.

5) **Collaboration and Workflow**
   - *Key Insight:* Collaborative tools and an agile methodology facilitated efficient teamwork and allowed for iterative improvements.
   - *Challenge:*Aligning schedules and expectations among team members proved challenging at times, particularly during critical deadlines.
   - *Improvement:*Establishing clear communication protocols and milestones at the project's outset can mitigate coordination challenges.

6) **Audience-Centered Approach**
   - *Key Insight:* The development of the visualizations was really tailored for the audience at hand. For instance, using industry-specific insights and straightforward visual elements made the data accessible to non-technical stakeholders.
   - *Challenge::*The balance between technical detail and simplicity across diverse audiences requires much forethought.
   - *Improvement:* Early engagement with the target audience to understand their preferences and expectations can inform better design choices.

7) **Data Interpretation and Storytelling**
   - *Key Insight:* Visualizations are most impactful if put together with a story behind them. Creating stories around the trend helped to contextualize it and make it actionable.
   - *Challenge:*Translating raw data into meaningful stories required iterative processes of trial, feedback, and revision.
   - *Improvement:*Developing a framework around storytelling, alongside efforts in visualization, could ensure coherence and impact.

8) **Technical and Analytical Skills**
   - *Key Insight:* The project brought to the fore the importance of technical skills in statistical analysis, machine learning, and visualization libraries.
   - *Challenge:*Some of the advanced techniques took extra time to implement and test, such as predictive modeling to forecast trends.

- **Improvement:** Leaving time for developing skills and trying new things in the planning phase will enhance the technical depth of future projects. This project underlines the most valuable lessons that can be learnt regarding the need for a structured approach, collaboration, and continuous improvement in presenting influential data visualization. This experience will provide a very useful base on which to build up greater efficiency and effectiveness for the team in future visualizations.

## IX. DATA ANALYSIS

### A. Wages

*1) By Race:* Over the past decade, racial wage disparities in the U.S. have been influenced by several key factors. Occupational segregation remains a significant issue, with many racial minorities concentrated in lower-paying industries, while White and Asian Americans are more represented in higher-paying sectors like technology and finance. Educational access has improved for some minority groups, but gaps in college graduation rates and advanced degrees continue to affect earning potential. Systemic barriers and biases in hiring and promotion processes also persist, hindering equal wage growth. Additionally, geographic and economic factors, such as limited access to well-paying jobs in rural or economically disadvantaged areas, particularly affect American Indians and Native Hawaiians. The COVID-19 pandemic further exacerbated these disparities, disproportionately impacting minority workers in low-wage, essential roles. Despite some positive changes through diversity initiatives and economic recovery, these ongoing factors explain why racial wage gaps remain prevalent.

*2) By Gender:* Throughout the last decade, the gender wage gap has slowly narrowed, but women still earn less than men on average in the U.S. Several factors contribute to this disparies. They are more likely to work in higher-paying industries such as technology, finance, and engineering often earn more than those in lower-paying fields like education and healthcare. Career interruptions, which are more common for those taking time for caregiving or other responsibilities, can also affect long-term career progression and earnings. Additionally, those in senior and executive roles typically receive higher salaries, and individuals who are more proactive in negotiating their pay often secure higher wages. These factors contribute to the overall wage gap, although the disparity is not always significant.

*3) By Industry Sector:* Over the past decade, wage gaps across different industries have remained due to varying factors like job demand, skill levels, and industry-specific challenges. In high-paying sectors such as technology and finance, wages have generally remained high due to continued demand for specialized skills and expertise, but competition for talent has also increased. In contrast, lower-paying industries like retail and hospitality have seen minimal wage growth, largely due to the prevalence of entry-level positions and the impact of automation and outsourcing. Healthcare has experienced wage increases, particularly for high-demand roles like doctors and nurses, driven by an aging population and greater emphasis on healthcare services. Manufacturing has faced stagnation in wages, partly due to offshoring and reduced domestic production. Overall, while certain sectors have experienced growth, the wage gap between industries remains significant, influenced by factors such as automation, globalization, and shifts in job requirements.

### B. In-depth Analysis by Industry Sector

The analysis focused on following key industry sectors and this approach highlighted sector-specific trends, wage patterns, and employment growth.

*1) Management, Business, Science & Art:* The analysis of the Management, Business, Science, and Arts sectors reveals that Management and Business had the largest workforce over the past decade, with Engineering following closely behind. However, as the years progressed, the engineering sector saw significant growth, surpassing Management and Business in population by 2018. Despite the shift in population, average wages in engineering have consistently been higher than in Management and Business throughout the period. The analysis shows a shift in the workforce, with the engineering sector growing rapidly and surpassing management and business in population by 2018. Despite this, engineering roles consistently command higher average wages, reflecting the high demand for specialized technical skills. The education sector experienced the highest wage growth in the past decade with a consistent workforce, driven by increasing demand for skilled educators and specialized roles. However, from 2020 onward, the healthcare industry overtook education in wage growth. This shift can be attributed to the increased demand for healthcare professionals during the COVID-19 pandemic, along with the ongoing advances in medical technology and an aging population, which have significantly raised wages in healthcare roles.

*2) Natural Resources, Construction & Maintenance:* Figure 7 visualizes the Natural Resources, Construction, and Maintenance Occupations, focusing on wage, population, and minor occupation group trends from 2014 to 2022. The total workforce numbers 16 million, categorized into Installation, Maintenance, and Repair Occupations, Construction and Extraction Occupations, and Farming, Fishing, and Forestry Occupations. The Installation, Maintenance, and Repair Occupations have the highest average wages and the largest population, while the Farming, Fishing, and Forestry Occupations have the smallest workforce and lowest wages. Wage differences among these groups depend on industries such as Manufacturing, Public Administration, and Educational and Health Services. The pie charts provide emphasis on the disparity in workforce size and earnings. While Installation, Maintenance, and Repair Occupations are unique because of their higher level of technical skills required and, hence, better wages, Farming, Fishing, and Forestry Occupations represent much lower economic opportunities. This dashboard highlights quite well the wide discrepancy in wages and distribution in the workforce among these occupations.

*3) Production, Transportation & Material Moving:* The total workforce is 77 million, divided between Production Occupations and Transportation & Material Moving Occupations. The minor occupation groups' average wage is $41.77K, short of the target wage of $46.17K by 9.52%, while detailed occupations in those groups have an average wage of $27.14K, surpassing the goal of $25.84K by 5.03%.

The detailed occupation breakdown shows high-skilled jobs such as Power Plant Operators and Aircraft Pilots, but other jobs like Packagers and Cleaners make significantly less. The minor occupations in wage distribution depict the disparities, with higher wages concentrated in specialized technical jobs that require advanced skills. Routine jobs requiring lower skill levels experience wage stagnation. This dashboard emphasizes the wage gap and shows how important skill specialization is in attaining higher wages within the sector.

*4) Sales & Office:* Over the years, Office & Administrative Support Occupations have comprised about 90% of the workforce in the Sales & Office Occupation sector, while Sales & Related Occupations have made up less than 10%. Despite this disparity in workforce size, Sales & Related Occupations have consistently earned higher average wages compared to Office & Administrative Support Occupations. Wages in Sales & Related roles have seen gradual increases over time, whereas wages in Office & Administrative Support Occupations have remained relatively stagnant with minimal growth. This wage difference can be attributed to several factors: Sales & Related roles often require specialized skills, performance-based pay, and offer commission opportunities, leading to higher earnings. In contrast, many Office & Administrative Support roles are more routine, require fewer specialized skills, and have seen less demand due to technological automation, which has slowed wage growth in this category.

*5) Service:* The Service Occupations sector is defined by a large, diverse workforce and has seen consistent wage growth over time. It is primarily dominated by the following three main categories: Protective Services, Building & Grounds Maintenance, and Healthcare Services. While Protective Services generally offers the highest compensation, both Protective Services and Healthcare Services have consistently made up the largest shares of the workforce. Even as Healthcare Services grew in workforce size, Protective Services continued to lead in earnings. Post-2020 trends indicate an increasing recognition of the value of service-oriented jobs, likely driven by the pandemic's impact on essential industries. The largest populations within the sector are in roles such as police officers, janitors, and nurses, while professions like physicians, fitness trainers, and pilots are less represented. This highlights the sector's wide diversity, both in the number of workers and the wages they earn. For instance, essential roles like nursing, maintenance, and food preparation vary greatly in terms of compensation. The average wage in 2014 was just above $35K, steadily rising to surpass $40K by 2022. This upward trend reflects consistent wage growth over time, with a notable acceleration post-2020, likely influenced by inflation and the increased demand for essential service occupations following the pandemic.

## X. VISUALIZATIONS

The employment data is presented through various visualizations, such as pie charts, bar graphs, and line graphs, created in Power BI. Carefully chosen colors, scales, and design elements are used to enhance clarity and ease of interpretation. These visual tools allow for an insightful and comparative analysis of key employment metrics, providing a clear view of trends, distributions, and patterns within the workforce over time.

### A. Visualizations of the U.S. job market's overall statistic



Fig. 1.   Average Wage of Industry Sector

Figure 1 presents a visualization of the overall dataset, which includes data for 655 million workers with an average wage of $52,920. The interactive slider allows users to select years between 2014 and 2022, providing a dynamic view of how wages and employment trends have changed over time. Selecting a year by the slider will update the other visualizations to reflect the chosen year.



Fig. 2.   Average Wage of Industry Sector

Figure 2 is a donut chart that compares the average wages across different industry sectors as follows:

- **Segmentation by Industry:**
  - The chart is divided into sections, each representing a different industry sector such as Public Services, Professional Services, Education, and Manufacturing.

– The size of each segment corresponds to the average wage of that industry relative to others.

- **Wage Distribution:**
  – Larger segments indicate industries with higher average wages, whereas smaller segments represent industries with lower average wages.
  – From the visual contrast, Professional Services and Public Services seem to have higher average wages compared to sectors like Education and Manufacturing.

- **Use of Colors:**
  – Different shades are used in order to make the sectors distinct from each other, hence making them clear and easily identifiable in the legend.

- **Insights:**
  – The chart depicts that the average wages in the sectors are different, which may reflect the difference in the nature of work, required skills, or demand for jobs in these industries.

This visualization provides a snapshot of wage disparities across sectors and could serve as a starting point for further analysis, such as investigating why certain industries pay more or less and what factors contribute to these differences.
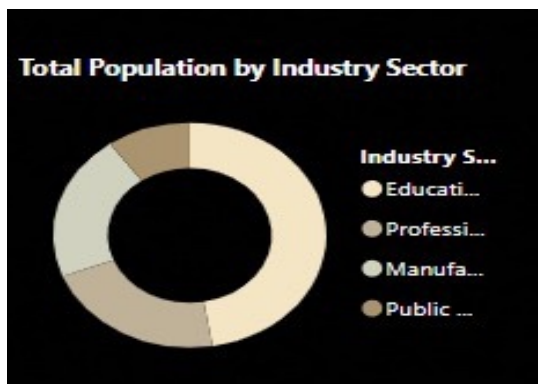


Fig. 3. Total Population by Industry Sector

Figure 3 is a donut chart representing the distribution of people employed in different industry sectors. Here's the explanation:

- **Industry Segmentation:**
  – It classified the workforce by sectors such as Education, Professional Services, Manufacturing, and Public Services.
  – The size of each segment covers the percentage of the total workforce employed in that sector.

- **Population Distribution:**
  – Larger sectors would mean the industries employing the higher share of the workforce. For example, Education and Public Services seem to employ the lion's share of the total population compared with Manufacturing or Professional Services.
  – The smaller one shows the industries that employ relatively fewer people.

- **Use of Colors:**

– Different shades distinguish sectors, and a corresponding legend shows the sector names.

- **Insights:**
  – This chart provides a quick view of the distribution of employment among sectors and hence might give an indication of the relative size and importance of the different industries in engaging the workforce.
  – For instance, Public Services may top the chart, meaning that a large number of people are employed in this sector due to the nature of the jobs being essential.

This provides a clear overview of the workforce distribution by industry, which is very useful in workforce planning, policy-making, or market analysis.
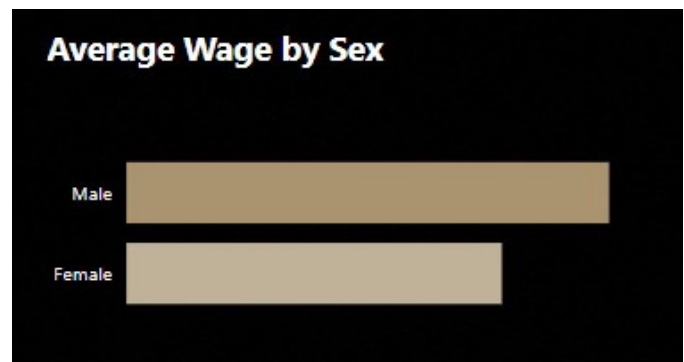


Fig. 4. Average Wage by Gender

The graph shows the comparison between the average wages of males and females. The following observations can be made:

- **Higher Average Wage for Males:** The length of the bar for males is visibly longer than that for females, which indicates that males earn a higher average wage compared to females.
- **Difference in Salary:** The bar length will reveal the gap in salaries; this, in simple words, tells about disparity in earnings of both genders.
- **Visual Comparison:** Representation of horizontal bars will enable comparability of the averages by eye with ease; the colors make differentiation easy between categories.

This visualization underlines the existing wage gap between males and females, one of the hot topics in discussions concerning equity and fairness in the workplace.
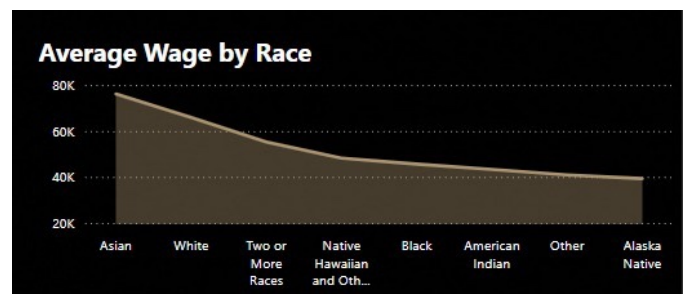


Fig. 5. Average Wage by Race

The graph above shows the average wages between the different races: Asian, White, mixed races, Native Hawaiian, American Indian, etc. The graph above depicts the following:

- **Significant Wage Disparities:** The chart displays substantial wage averages across the racial groups, ranging from $80k for Asian Americans to $40k for Black Americans, American Indian, and Alaska Native individuals.
- **Highest Average Wage:** Asian Americans have the highest average wage among the racial groups shown.
- **Lowest Average Wage:** Black Americans, American Indian, and Alaska Native individuals have the lowest average wages depicted in the chart.

The visual above shows significant wage disparities across the different racial groups in America, which likely reflect complex societal, economic, and historical factors contributing to inequalities. The visualization highlights the need to further examine and address the underlying issues driving these unequal outcomes.
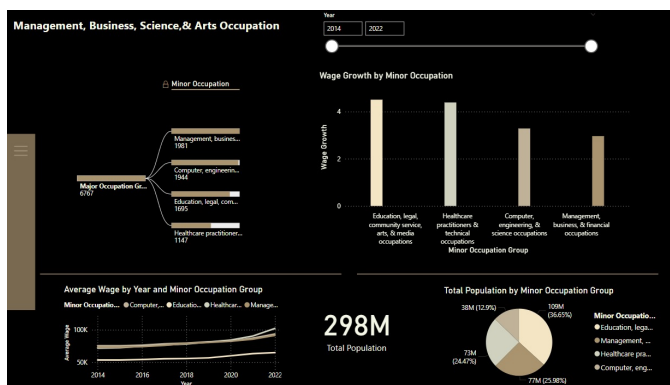
## B. Industry-specific Visualizations



Fig. 6.   Visualizations of Management, Business, Science, Arts sector

**Figure 6** dashboard visualizes Management, Business, Science, and Arts Occupations, considering wage, population, and occupation trends from the period 2014-2022. Now let's walk through the details behind it:

- **Major and Minor Occupation Groups:** It shows a hierarchy that includes breaking down Major Occupation Group into Minor Occupation Groups.
  - Management, Business, and Financial Occupations: 1,981
  - Computer, Engineering, and Science Occupations: 1,944
  - Education, Legal, Community Service, Arts, and Media Occupations: 1,695
  - Healthcare Practitioners and Technical Occupations: 1,147
  - This suggests that the workforce is fairly well spread out across these groups, with healthcare being a little smaller in population compared to other groups.
- **Wage Growth by Minor Occupation:** The bar graph represents the wage growth, 2014 to 2022, for each minor occupation group. Specific highlights are as follows:

- Healthcare Practitioners and Technical Occupations had the largest growth in wages.
- Education, Legal, Community Service, Arts, and Media Occupations also witnessed relatively higher wage increases, indicating rising requirements or pure inflationary adjustments in these sectors.
- Computer, Engineering, and Science Occupations and Management, Business, and Financial Occupations registered a medium growth in average wages.
- This could well depict that there are different economic cycles around each of these occupational groups

- **Average Wage by Year and Minor Occupation Group:** The line chart maps the average wage growth for each minor occupation group over 2014 to 2022:
- Healthcare Practitioners and Technical Occupations have shown a steady rise, which reflects the same trend that is observed in the above graph on wage increase.
- Management, Business, and Financial Occupations** also present a regular wage increase over the years.
- This chart shows that all categories saw wage increases, but at varying rates.
- **Total Population by Minor Occupation Group:** The pie chart divides the total workforce population (298 million) by minor occupation groups:
  - Management, Business, and Financial Occupations**: 109M (36.65%)
  - Computer, Engineering, and Science Occupations**: 77M (25.98%)
  - Education, Legal, Community Service, Arts, and Media Occupations**: 73M (24.47%)
  - Healthcare Practitioners and Technical Occupations**: 38M, 12.9%
  - The above distribution clearly shows that management occupations top the chart while healthcare is few but essential.

**Key Takeaways:**

- **Wage Trends:** Healthcare occupations have seen the highest growth in wages probably due to increased demand for medical professionals and technical expertise.
- **Population Distribution:** The largest share of the workforce is held by management occupations, reflecting their pervasiveness across industries.
- **Economic Insights:** Education and health show wage growth, indicating a focus on societal needs, while tech and management are steady and robust.
- **Time Comparison:** A timeline comparison is drawn out in the dashboard from 2014 to 2022, focusing on growth trends and shifting dynamics of the workforce.

**Conclusion:** This dashboard effectively shows the evolution of various minor occupation groups within the major category of Management, Business, Science, and Arts Occupations in terms of workforce size and wage growth. It points to healthcare and education as high-growth areas, while management remains the

largest in terms of workforce population. The workforce planning, policy decisions, and economic strategies could be usefully informed by this analysis.
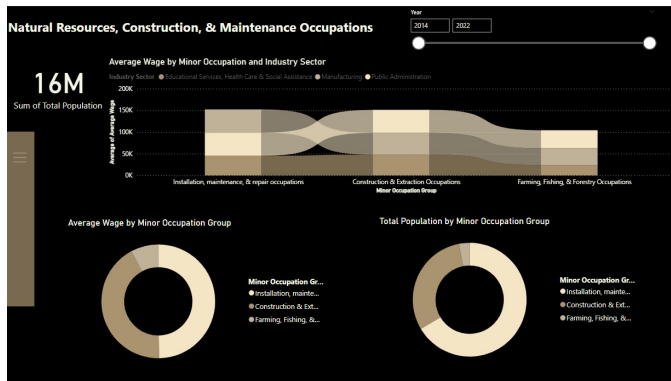


Fig. 7. Visualizations of Management, Business, Science, Arts sector

**Figure 7** visualizes the **Natural Resources, Construction, and Maintenance Occupations**, focusing on wage, population, and minor occupation group trends from 2014 to 2022. The total workforce numbers 16 million, categorized into Installation, Maintenance, and Repair Occupations, Construction and Extraction Occupations, and Farming, Fishing, and Forestry Occupations. The Installation, Maintenance, and Repair Occupations have the highest average wages and the largest population, while the Farming, Fishing, and Forestry Occupations have the smallest workforce and lowest wages. Wage differences among these groups depend on industries such as Manufacturing, Public Administration, and Educational and Health Services.

The pie charts provide emphasis on the disparity in workforce size and earnings. While Installation, Maintenance, and Repair Occupations are unique because of their higher level of technical skills required and, hence, better wages,Farming, Fishing, and Forestry Occupations represent much lower economic opportunities. This dashboard highlights quite well the wide discrepancy in wages and distribution in the workforce among these occupations.



Fig. 8. Visualizations of Management, Business, Science, Arts sector

**Figure 8** is focused on wages, population, and occupational

details related to **Production, Transportation, and Material Moving Occupations** from 2014 to 2022. In total, there are 77 million in the workforce of these two occupations: Production Occupations and Transportation & Material Moving Occupations. The minor occupation groups' average wage is $41.77K, missing the $46.17K goal by -9.52%. However, detailed occupations from these minor occupation groups yielded an average wage of $27.14K, beating out the $25.84K goal by 5.03%.

The treemap classifies detailed occupations, from highest to lowest wages, ranging from Power Plant Operators and Aircraft Pilots to Packagers and Cleaners. The bottom chart shows a broad range of wages across occupations, sometimes with large discrepancies within minor groups. This dashboard conveys wage disparity and workforce distribution in jobs in production and transportation and gaps toward targets of growth in wages.
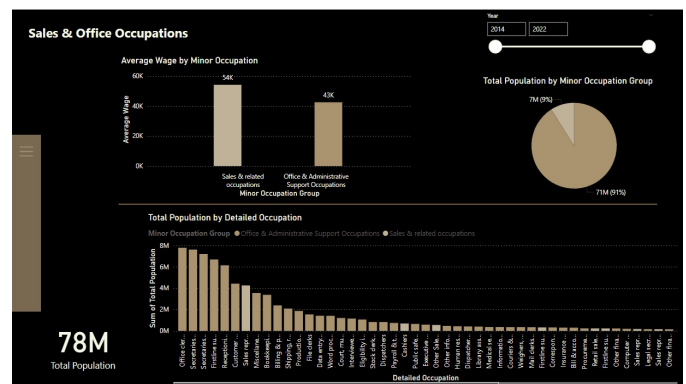


Fig. 9. Visualizations of Management, Business, Science, Arts sector

**Figure 9** provides insights into **Sales and Office Occupations**, covering wages, population, and detailed roles. The total workforce is 78 million, with 91% (71M) in Office and Administrative Support Occupations** and 9% (7M) in Sales and Related Occupations. The average wage is higher for Sales roles at $54K compared to $43K for Office roles, highlighting a wage disparity between these minor occupation groups.

The bar chart details population by specific occupations, with Office Clerks and Secretaries representing the largest workforce segments, while roles like Library Assistants and Other Sales Occupations have the smallest. This dashboard highlights the dominance of administrative support in workforce size but underscores higher earning potential in sales roles, reflecting differing demand and skill requirements across these groups.
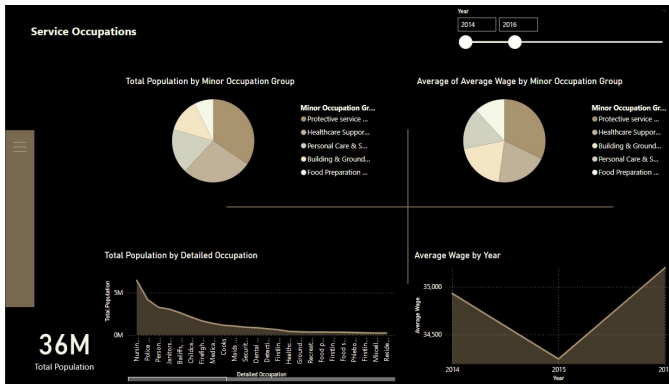
Fig. 10.   Visualizations of Management, Business, Science, Arts sector

**Figure 10** focuses on the sector **Service Occupations**, giving further insights into population, wages, and occupation group analysis. There is a total workforce of 36 million, distributed among Protective Services, Healthcare Support, Personal Care and Service, Building and Grounds Cleaning and Maintenance, and Food Preparation and Serving Occupations. Protective Services are the smallest population, while Healthcare Support and Personal Care dominate.

The average wage distribution reflects Protective Services as the highest-paid segment and Food Preparation and Serving as the lowest paid. From the detailed occupation chart, it can be observed that Nursing Assistants and Police Officers are bigger segments of the workforce, whereas smaller roles include Recreation Workers. The average wage trend from 2014 to 2016 is gradually increasing, showing consistent growth in the earnings of service occupations. This dashboard shows the variation in wages and size of the workforce for service-related jobs.

## XI. FUTURE WORK

1) **Predictive Models for Future Trends**
   - *Enhancement:* Develop machine learning models to forecast future trends in skill demand, salary growth, and job availability.
   - *Importance:* Adding foresight to your research allows stakeholders to prepare for and adapt to emerging opportunities and challenges in the job market.

2) **Real-Time Data Integration**
   - *Enhancement:* Integrate real-time labor market data from platforms such as LinkedIn, Glassdoor, or government databases.
   - *Importance:* Real-time insights provide up-to-date trends and make the research actionable for policymakers, industries, and job seekers.

3) **Demographic and Equity Analysis**
   - *Enhancement:* Trend analysis by demographics, such as gender, race, age, including wage gaps and employment impediments.
   - *Importance:* Many stakeholders are looking toward ways to promote equity and inclusion. This analysis would provide actionable recommendations for workforce diversity.

4) **Impact of Emerging Technologies**
   - *Enhancement:* Understand from the perspective of research how AI, blockchain, and automation are transforming job creation, skill requirements, and the transformation of industries.
   - *Importance:* The emergence of technologies is a very vital driver in the changing labor markets, and knowing its impacts will future-proof your research.

5) **Policy and Workforce Training Recommendations**
   - *Enhancement:* Utilize the findings of the research to suggest policies that could address skill gaps, promote workforce mobility, or support lifelong learning programs.
   - *Importance:* Help governments and industries foster a resilient workforce prepared for future challenges.

These enhancements balance actionable insights with technological depth and stakeholder relevance to keep the project impactful and forward-looking.

## XII. CONCLUSION

Significant changes in the job market over the past decade have been driven by automation, remote work, freelancing, and an increasing demand for specialized skills and flexibility. These shifts have impacted industries such as technology, finance, healthcare, and hospitality. Key trends highlighted in the data include the dominance of sectors like educational services and professional / scientific / technical services, as well as higher wages in public administration and professional / scientific / technical services. However, wage gaps by gender and race point to ongoing inequalities that need attention. This analysis not only looks at current trends, but also forecasts future employment changes, helping job seekers, educators, and policymakers make informed decisions. Looking at how the economy, technology, and workforce are connected, the study provides helpful insights and practical strategies for adapting to the changing job market and preparing for the future of work.

### REFERENCES

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[3] Demo Link: https://youtu.be/RkWNNF758y0.