Optimizing Job Workflow and Skilled Labor Availability for Increased Manufacturing Business Profitability
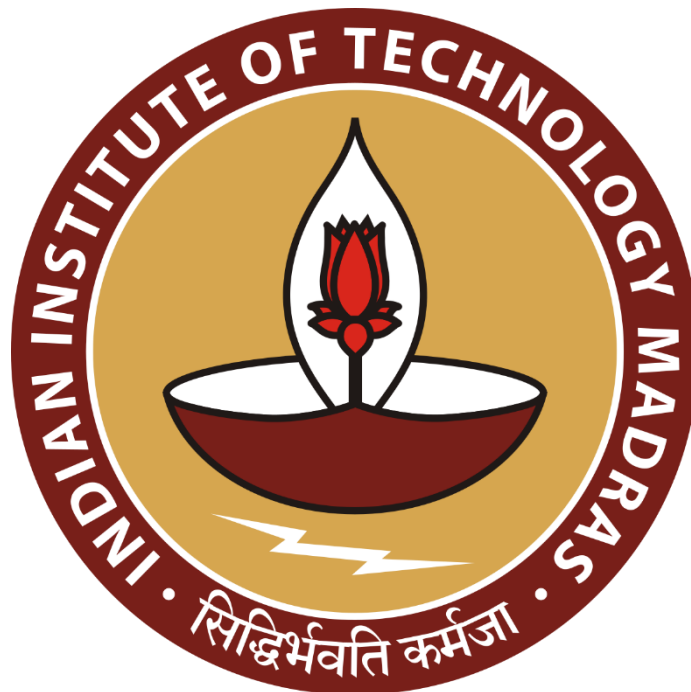
A Final Submission Report for the BDM Capstone Project

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1. Executive Summary

Optimizing Job Workflow and Skilled Labor Availability for Increased Manufacturing Business Profitability

The project is centered around addressing challenges faced by a small-scale auto component manufacturing company located in Vellore, Tamil Nadu. This B2B business struggles with maintaining a consistent flow of job work, ultimately affecting its profitability. Additionally, a scarcity of qualified and skilled workers further exacerbates the situation.

To tackle these issues, the project is designed to employ analytical approaches involving customer analysis, in-depth exploration of costs within a specific industry segment, and a comprehensive assessment of employee value. Data from invoices, purchase records, and employee profiles will be analyzed. Simultaneously, the project aims to strengthen the company's recruitment strategies to attract proficient personnel, leading to positive outcomes.

The project's desired outcome is to enhance the company's job work consistency, thereby boosting its overall profitability. By implementing effective recruitment tactics, the company intends to draw in and retain skilled workers, fostering improved performance and productivity across the organization.

Ultimately, the core objective of this initiative is to optimize job workflows and address the shortage of skilled labor at Karthik Engineering Works, a small-scale manufacturing company in Vellore, Tamil Nadu. By harnessing advanced analytical techniques to scrutinize diverse datasets, the project aspires to elevate the company's profitability, expand its customer base, and enhance employee retention strategies.

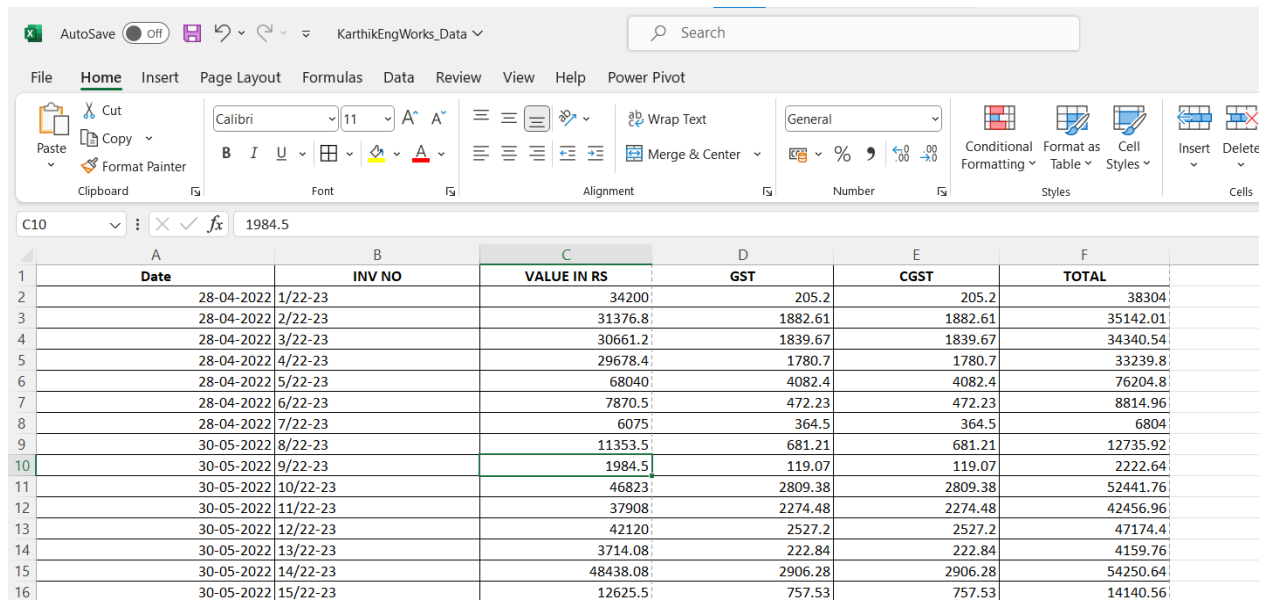## 2. Detailed Explanation of Analysis Process/Method

The analysis process/method for the Karthik Engineering Works project involves several steps to extract insights from the collected data. Here is a detailed explanation of the analysis process:

> ### Data Collection:

The first initial task involves procuring essential data from Karthik Engineering Works. This procedure entails extracting pertinent information from multiple sources, such as purchases, invoices, and employee attendance records. The dataset is specifically gathered over the preceding year (April 2022 to April 2023) and is conveniently shared by the owner in Excel format, facilitating thorough analysis for valuable insights.
All the collected data is uploaded to the colab notebook to do the analysis

Invoice & Consolidated Job work data:

	Date	INV NO	VALUE IN RS	GST	CGST	TOTAL
1	Date	INV NO	VALUE IN RS	GST	CGST	TOTAL
2	28-04-2022	1/22-23	34200	205.2	205.2	38304
3	28-04-2022	2/22-23	31376.8	1882.61	1882.61	35142.01
4	28-04-2022	3/22-23	30661.2	1839.67	1839.67	34340.54
5	28-04-2022	4/22-23	29678.4	1780.7	1780.7	33239.8
6	28-04-2022	5/22-23	68040	4082.4	4082.4	76204.8
7	28-04-2022	6/22-23	7870.5	472.23	472.23	8814.96
8	28-04-2022	7/22-23	6075	364.5	364.5	6804
9	30-05-2022	8/22-23	11353.5	681.21	681.21	12735.92
10	30-05-2022	9/22-23	1984.5	119.07	119.07	2222.64
11	30-05-2022	10/22-23	46823	2809.38	2809.38	52441.76
12	30-05-2022	11/22-23	37908	2274.48	2274.48	42456.96
13	30-05-2022	12/22-23	42120	2527.2	2527.2	47174.4
14	30-05-2022	13/22-23	3714.08	222.84	222.84	4159.76
15	30-05-2022	14/22-23	48438.08	2906.28	2906.28	54250.64
16	30-05-2022	15/22-23	12625.5	757.53	757.53	14140.56

Date	ComponentName	Industry who Gives Job	Delivered Qty					
01-04-2022	127013101202-LP SHAFT (FACING AND OD ONLY)	Worth Industries	800			Row Labels	Sum of Delivered Qty	
18-04-2022	127013101202-LP SHAFT (FACING AND OD ONLY)	Worth Industries	1375			Maruthi Engineering Works	5.58%	
19-04-2022	127013101202-LP SHAFT (FACING AND OD ONLY)	Worth Industries	897			Worth Industries	94.42%	
20-04-2022	127013101202-LP SHAFT (FACING AND OD ONLY)	Worth Industries	900			Grand Total	100.00%	
28-04-2022	127013101202-LP SHAFT (FACING AND OD ONLY)	Worth Industries	475					
29-04-2022	127013101202-LP SHAFT (FACING AND OD ONLY)	Worth Industries	600		Karthik Eng	Maruthi Eng Works	Distance	24.7 Kms
30-04-2022	127013101202-LP SHAFT (FACING AND OD ONLY)	Worth Industries	600		Karthik Eng	Worth industries	Distance	2.1 Kms
01-04-2022	1586C0300204-ADAPTOR BLOCK	Worth Industries	225					

Employee Attendance Data

Employee Name	Age	Date of Joining	Date of relieving	Compensation	Total working days
Anbu	26	04-08-2022	21-01-2023	8500	147
Suresh	28	17-08-2021	02-12-2022	9000	406
Kanniappan	30	19-05-2021	02-05-2022	8000	299
Murthy	33	03-08-2021	03-08-2022	8500	314
Kaalan	36	02-04-2022	30-08-2022	9000	129
Gopalakrishnan	44	11-12-2022	16-06-2023	10000	161
Ramalingam	45	03-02-2021	NA	10500	#VALUE!
Vetrivel	45	26-05-2022	04-01-2023	10500	192
Rajamanikkam	46	15-10-2022	12-06-2023	12500	206
Rajan	48	26-12-2021	NA	12000	#VALUE!
Rajesh	54	24-10-2021	NA	12000	#VALUE!
Ganesh	54	13-08-2022	21-07-2023	13000	294
Kumar	55	22-04-2021	NA	13500	#VALUE!

➢ **Data Description:**

There are 8 columns for Purchase data, 6 columns for Invoice data, 7 columns for Job work data, and 6 columns for employee details data. I used pandas to analyze the type of each column.

```
Data columns (total 8 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   B.Dt              76 non-null     datetime64[ns]
 1   B.No              76 non-null     object
 2   GSTIN             76 non-null     object
 3   Party             76 non-null     object
 4   Taxable value     76 non-null     float64
 5   CGST              76 non-null     float64
 6   IGST              76 non-null     float64
 7   Total  Bill Amount 76 non-null    float64
```

6

```
Data columns (total 6 columns):
 #   Column        Non-Null Count  Dtype
---  ------        --------------  -----
 0   Date          102 non-null    datetime64[ns]
 1   INV NO        102 non-null    object
 2   VALUE IN RS   101 non-null    float64
 3   GST           102 non-null    float64
 4   CGST          102 non-null    float64
 5   TOTAL         102 non-null    float64
```

```
Data columns (total 7 columns):
 #   Column          Non-Null Count  Dtype
---  ------          --------------  -----
 0   Date            414 non-null    datetime64[ns]
 1   Component Name  451 non-null    object
 2   WT DC NO        123 non-null    object
 3   Received Qty    125 non-null    object
 4   KEW DC No.      339 non-null    float64
 5   Delivered Qty   338 non-null    object
 6   Rej Qty
(UW/LR)   89 non-null     object
dtypes: datetime64[ns](1), float64(1), object(5)
```

```
Employee Name         object
Age                    int64
Date of Joining       object
Date of relieving     object
Compensation           int64
Total working days     int64
dtype: object
```

Once the data is collected, it needs to be cleaned and prepared for analysis. This involves identifying and handling any missing or incorrect data, removing duplicates, and ensuring data consistency.

➢ Data Preprocessing:

After reviewing the data, it became apparent that there were inconsistencies in some of the data types, as well as missing values and improper date formats in certain rows. To ensure accurate analysis, several data cleaning and preprocessing steps were performed.

Data Transformation: The first step involved correcting the format of columns such as "Date" in both the Purchase and Invoice data. The dates were standardized to a consistent format across all rows.

Next, unwanted rows that contained no values were removed from the dataset. Additionally, any duplicate rows, if present, were also eliminated to avoid redundancy.

By implementing these data cleaning and preprocessing techniques, the data became more coherent and ready for further analysis.

```
3
4 # Convert the 'Purchase Date' column to datetime type
5 df['Purchase Date'] = pd.to_datetime(df['Purchase Date'], format='%d-%m-%Y', errors='coerce')
6 print(df)
7
```

```
4 # Convert the 'Purchase Date' column to datetime type
5 df1['Invoice Date'] = pd.to_datetime(df1['Invoice Date'], format='%d-%m-%Y', errors='coerce')
6 print(df1)
7
8 # Group the data by month and calculate the sum
9 monthly_summary = df1.groupby(pd.Grouper(key='Invoice Date', freq='M')).sum()
10 print(monthly_summary)
```

➢ Data Analysis:

The analysis is divided into 3 parts

- Temporal Trends: Merge purchase and invoice data to analyze monthly profitability trends and identify months with increased profits.

- Distance Factor Analysis: Analyze total jobs data to assess how distance and cost per component influence job allocation to suppliers, providing insights on the impact of geographical proximity.

- Employee Attrition Analysis: Present concise insights and well-informed recommendations derived from the analyses to address issues, optimize profitability, and enhance employee retention.

➢ **Data Visualization**:

Visual representations, such as graphs, charts, and tables, are created to present the data in a more accessible and understandable format. This step involves selecting appropriate visualization techniques based on the nature of the data and the insights to be conveyed. Common types of visualizations include bar charts, line graphs, pie charts, and heat maps.

3. Results and Finding

❖ **Temporal Trend Analysis**

This analysis by integrating purchase and invoice data, this analysis allows for the exploration of monthly trends in profitability. This involves merging datasets to create a comprehensive overview, enabling the identification of months with notable profit surges. Through this amalgamation, valuable insights can be extracted, aiding in informed strategic choices and improved financial planning. This phase concentrates on merging purchase and invoice data to execute a monthly summary analysis, aiming to pinpoint patterns and trends in profitability over distinct months, thereby highlighting periods of enhanced profitability.
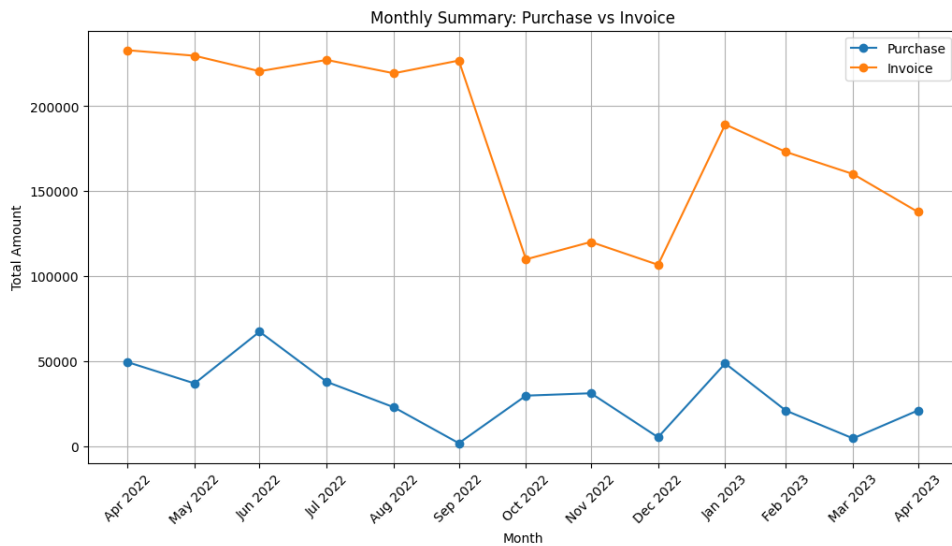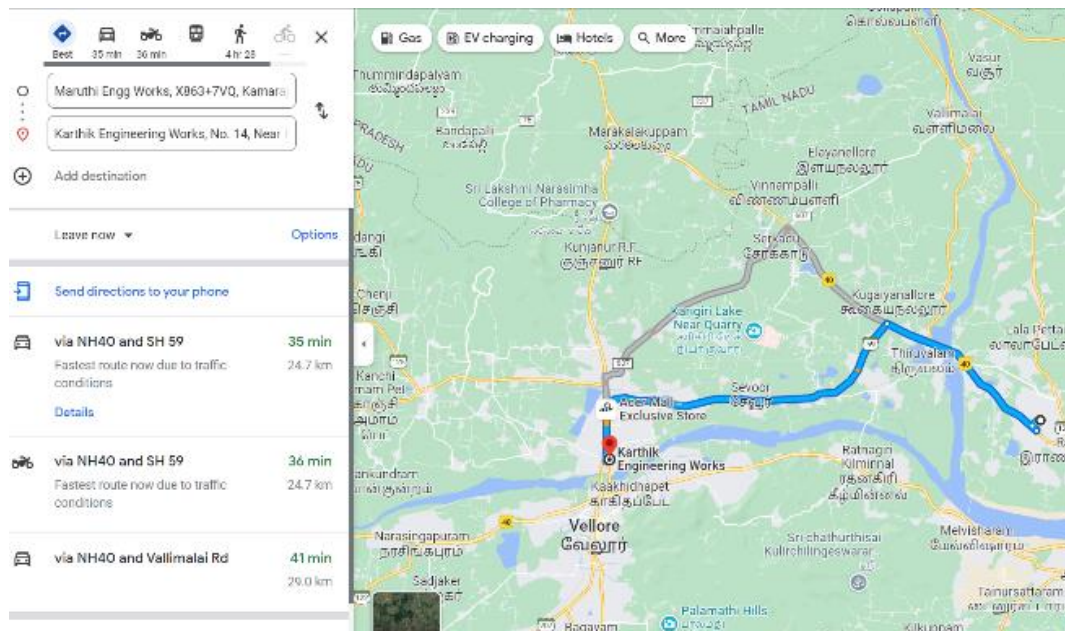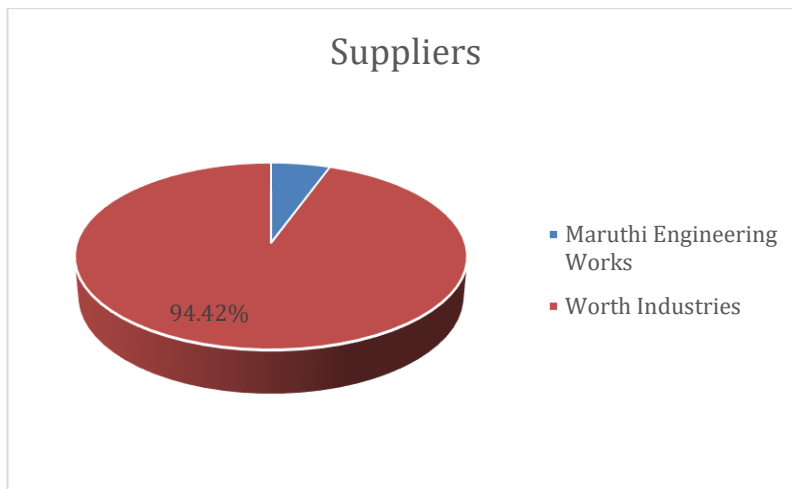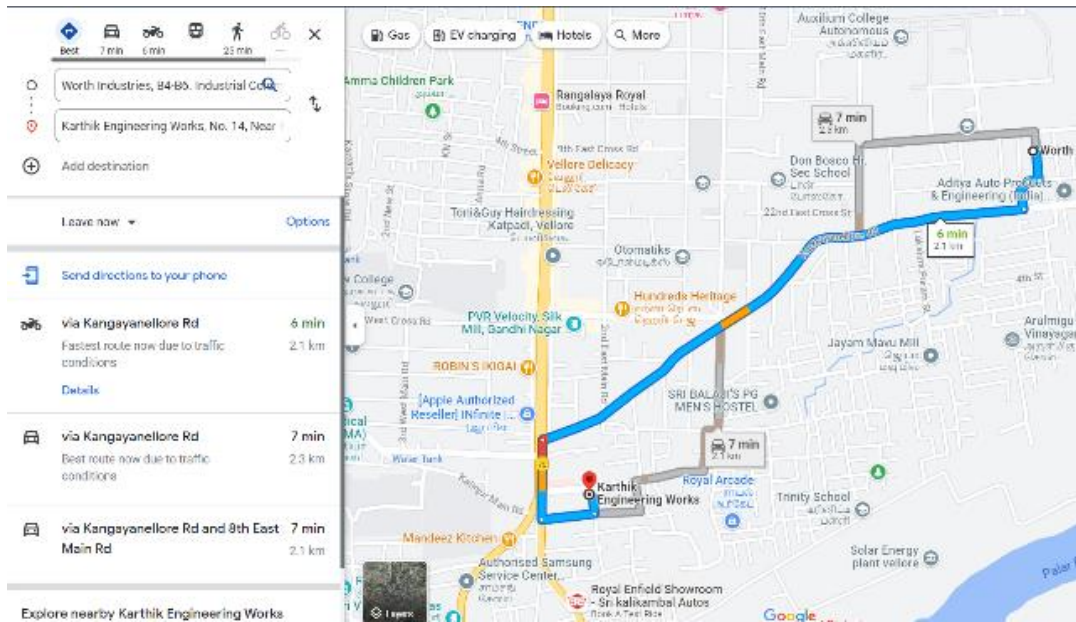
Findings

Integrating purchase and invoice data highlighted noticeable monthly fluctuations in profitability. we found that the company's profits were highest in June 2022 and lowest in January 2023. This suggests that there is a seasonal variation in demand for auto components and that the company needs to diversify its customer base to reduce its dependency on a few industries. Moreover, the profit increases, signaling effective strategies or heightened customer demand during those timeframes.

❖ **Distance Factor Analysis**

This analysis leverages the complete jobs dataset to assess how distance relates to the allocation of jobs to suppliers based on their costs per component. The objective is to understand how geographical proximity influences the distribution of jobs. Through this scrutiny, valuable insights are gleaned to enhance supplier selection and logistics choices. This component focuses on utilizing total jobs data to analyze how distance factors into supplier job allocation, with specific attention to the impact of cost per component on this process. The aim is to discern how proximity considerations affect the distribution of jobs to suppliers.

Suppliers

94.42%

- Maruthi Engineering Works
- Worth Industries

Findings

Upon analysis, a clear correlation emerged between geographical distance and the allocation of jobs to suppliers. Notably, suppliers situated closer, such as Worth Industries, were frequently favored recipients of job assignments. Furthermore, the decision-making process for job allocation appeared to be influenced by the cost per component. Suppliers offering competitive pricing received a higher volume of jobs, suggesting a delicate equilibrium between proximity and cost-effectiveness. By tactfully considering both distance and cost, the company can streamline its job allocation process, optimize resource management, and enhance operational efficiency.

In summary, our findings indicate a strong inclination towards assigning tasks to suppliers in closer proximity with lower costs per component. This underscores the pivotal roles that distance and cost play in shaping job allocation decisions. To achieve

more efficient resource utilization, the company should explore strategies that synergize these factors while making allocation decisions.

❖ Employee Attrition Analysis

The analysis of employee attrition delves into departures by examining job satisfaction, compensation, and growth opportunities. Derived insights steer well-informed recommendations to tackle turnover challenges, elevate profitability, and fine-tune retention strategies. Provide succinct insights and knowledgeable suggestions resulting from the analysis to effectively address concerns, enhance profitability, and optimize employee retention.
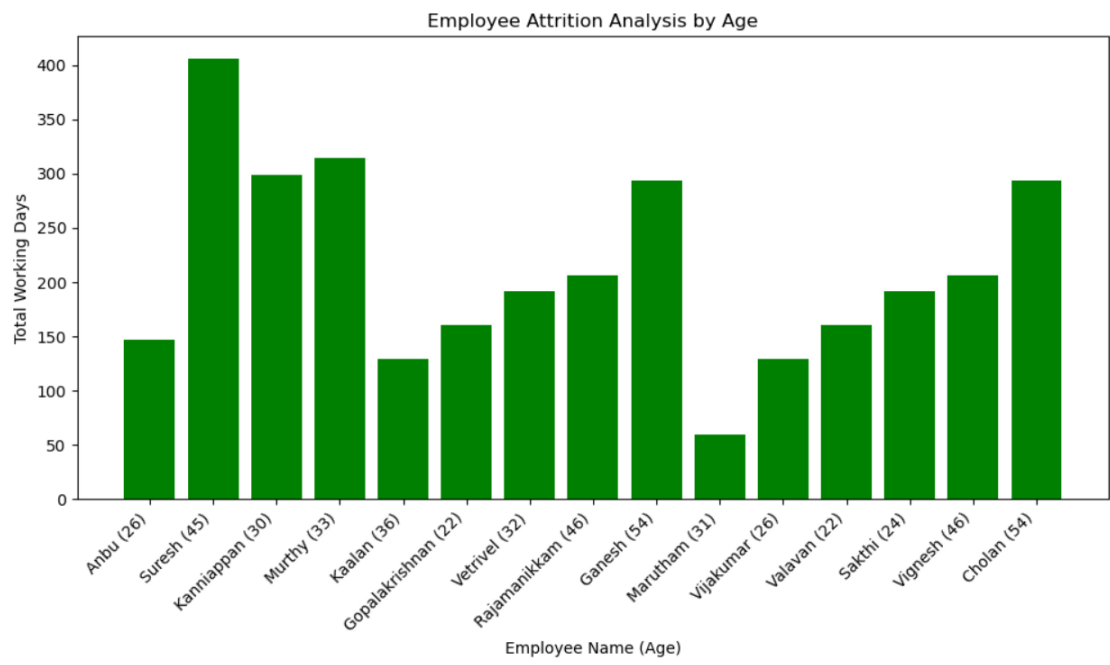
Findings

The findings revealed that job satisfaction, compensation, and growth opportunities significantly influence departure rates. Employees aged 22 - 35 with lower job satisfaction and inadequate compensation are more likely to leave the company. Conversely, those seeking growth prospects tend to stay longer. To address turnover challenges, it's crucial to enhance job satisfaction, adjust compensation structures, and provide clear pathways for career development. These actions not only improve employee retention but also contribute to elevated profitability and optimized retention strategies.

4. Interpretation of Results and Recommendations:

❖ Temporal Trend Analysis

The temporal trend analysis of integrated purchase and invoice data has unveiled significant monthly fluctuations in the company's profitability. Notably, the company achieved its highest profits in June 2022 and encountered the lowest in January 2023. This pattern implies the presence of a seasonal demand variation for auto components. Furthermore, the observed profit surges in certain months suggest the implementation of effective strategies or a surge in customer demand during those periods.

Recommendations:

Based on the analysis findings, the company should consider the following recommendations to optimize its operations and profitability:

- **Diversify Customer Base:** To mitigate the impact of seasonal variations, the company should aim to diversify its customer base across multiple industries. This strategic move can reduce dependency on specific sectors and stabilize revenues throughout the year.

- **Strategic Planning:** By identifying the effective strategies associated with profit surges, the company can proactively replicate these successful approaches during other months. This includes adapting pricing strategies, marketing efforts, or product launches to capture heightened customer demand.

- **Market Research:** Conduct thorough market research to understand the underlying reasons behind the fluctuating demand patterns for auto components. This can aid in aligning production and inventory management with anticipated market trends.

- **Supply Chain Flexibility:** Establish a flexible supply chain that can quickly adjust to changes in demand. This ensures the company can meet increased customer requirements during periods of heightened demand.

In summary, the analysis highlights the importance of understanding and responding to seasonal demand variations. By diversifying the customer base, strategically planning for profit surges, conducting market research, and optimizing the supply chain, the company can better manage its profitability and achieve more stable financial performance.

❖ Distance Factor Analysis

The distance factor analysis reveals a significant relationship between geographical proximity, cost per component, and the allocation of jobs to suppliers. The analysis demonstrates that suppliers located closer, such as Worth Industries, receive a higher frequency of job assignments, highlighting the influence of proximity on the distribution of tasks. Moreover, the study indicates that the decision-making process for job allocation is sensitive to the cost per component, with suppliers offering competitive pricing attracting more job assignments.

Recommendations:

In order to further optimize the job allocation process and resource management, the company can consider the following recommendations:

- **Strategic Supplier Collaboration:** Strengthen collaborations with suppliers located in closer proximity. Leveraging the established proximity advantage can lead to enhanced efficiency in job allocation and quicker turnaround times.

- **Cost-Benefit Analysis:** Conduct a comprehensive cost-benefit analysis to identify the optimal balance between proximity and cost-effectiveness, considering factors such as transportation costs and supplier pricing. This will assist in making informed decisions when allocating jobs to different suppliers.

- **Supplier Relationship Enhancement:** Develop strong relationships with suppliers offering competitive pricing and high-quality components. This can lead to long-term partnerships that support cost-effective job allocation. Additionally, involving suppliers in the development of new components can foster innovation and mutual benefits.

- **Resource Optimization:** Utilize data-driven insights to allocate jobs strategically, ensuring that both proximity and cost considerations are weighed. This can lead to optimized resource utilization and minimized transportation costs. Incorporating the production of new components into this strategic allocation can also streamline operations.

- **Technology Adoption:** Explore technology solutions such as supply chain management software that can aid in real-time job allocation decisions based on both proximity and cost factors. These solutions can be extended to include the management of new component development processes, ensuring efficient

coordination.

In summary, the analysis underscores the importance of considering both proximity and cost in supplier job allocation decisions. By capitalizing on proximity advantages, strategically managing supplier relationships, and leveraging technology, the company can enhance its operational efficiency and resource utilization. Furthermore, integrating the development of new components into this framework can contribute to innovation and overall process improvement.

❖ Employee Attrition Analysis

The employee attrition analysis underscores the multifaceted nature of factors contributing to employee departures. It highlights the critical impact of job satisfaction, compensation, and growth opportunities on employee retention. The findings suggest that a dissatisfied work environment and inadequate compensation can lead to higher turnover rates. Conversely, employees seeking opportunities for career growth tend to stay longer, emphasizing the significance of professional development within the organization.

Recommendations:

Based on the analysis findings, the following recommendations can be made to address turnover challenges, enhance profitability, and optimize employee retention:

- **Enhance Job Satisfaction:** Prioritize efforts to improve the overall job satisfaction of employees. This can include creating a positive work culture, recognizing and valuing employee contributions, and offering opportunities for feedback and suggestions.

- **Competitive Compensation:** Conduct market research to ensure that compensation packages are competitive within the industry. A fair and competitive compensation structure can contribute to employee satisfaction and reduce the likelihood of departures.

- **Career Development Programs:** Implement structured career development programs that provide employees with clear pathways for growth within the organization. Offering training, mentorship, and opportunities for skill enhancement can contribute to higher retention rates.

- **Performance Recognition:** Implement a robust performance recognition system to acknowledge and reward employees' accomplishments. Recognizing

employees' efforts and achievements can foster a sense of appreciation and loyalty.

- **Work-Life Balance:** Emphasize the importance of work-life balance and promote flexible working arrangements when feasible. A balanced work environment can enhance job satisfaction and overall well-being.

- **Exit Interviews:** Conduct thorough exit interviews with departing employees to gather insights into their reasons for leaving. This information can help identify specific areas for improvement and refine retention strategies.

- **Employee Feedback:** Regularly seek feedback from employees through surveys or open communication channels. Act on the feedback received to address concerns and make necessary improvements.

In summary, the analysis highlights the pivotal role of job satisfaction, compensation, and growth opportunities in employee retention. By focusing on creating a satisfying work environment, offering competitive compensation, and fostering professional growth, the company can minimize turnover challenges, drive profitability, and optimize its retention strategies.

5. Timeline for Plan Implementation:

➢ Optimizing Job Workflow Timeline:

Week 1:

1. Present the findings of the temporal trend analysis and distance factor analysis to senior management and relevant teams.
2. Initiate cross-functional discussions to align strategies for customer diversification and supplier collaboration.

Week 2:

1. Formulate an integrated optimization plan that incorporates insights from both analyses to address seasonal demand variations and supplier job allocation.
2. Identify potential synergies between customer diversification and supplier collaboration strategies.

Week 3:

1. Develop a comprehensive plan for targeted marketing campaigns that cater to new customer segments identified through diversification efforts.
2. Detail supplier collaboration initiatives, considering both distance and cost factors, emphasizing the importance of proximity.

Week 4:

1. Launch marketing campaigns targeting new customers from diversified industries, showcasing the company's adaptability to their unique needs.
2. Implement supplier collaboration strategies that weigh both distance advantage and cost-effectiveness for optimized job allocation.

Week 5 and Onwards:

1. Monitor sales data, customer feedback, and supplier performance to assess the effectiveness of optimization efforts.
2. Continuously adapt marketing campaigns and supplier allocation decisions based on real-time insights to maintain alignment with demand fluctuations.

Ongoing Weeks:

1. Establish an ongoing feedback loop among departments to share insights and experiences gathered during the implementation process.
2. Utilize feedback to fine-tune marketing strategies and supplier allocation processes, ensuring continuous improvement.
3. Regularly review and update the optimization plan to remain responsive to evolving market dynamics and business needs.
4. Incorporate new insights, technological advancements, and emerging industry trends into the plan to sustain competitiveness.

By following this timeline, Karthik Engineering Works can implement a comprehensive and dynamic strategy that optimizes job workflow, effectively addresses seasonal demand variations, and maximizes operational efficiency while enhancing profitability.

➢ Employee Attrition Analysis Implementation Plan:

Week 1:

3. Share employee attrition analysis findings with HR and management.
4. Initiate discussions on implementing employee satisfaction enhancement initiatives.
5. Identify potential collaboration opportunities with nearby ITI institutes for skilled young employees.

Week 2:

1. Develop and launch employee satisfaction enhancement programs.
2. Begin market research to assess compensation competitiveness.
3. Establish connections with ITI institutes and explore recruitment partnerships.

Week 3:

1. Introduce structured career development programs for employees.
2. Promote work-life balance initiatives within the organization.
3. Collaborate with ITI institutes to design internship programs for students.

Week 4:

1. Implement a performance recognition system to acknowledge employee achievements.
2. Initiate regular feedback collection mechanisms from employees.
3. Finalize the details of internship programs and develop onboarding processes.

Week 5 and onwards:

1. Monitor employee satisfaction and retention rates.
2. Conduct exit interviews with departing employees to gather insights.
3. Launch internship programs in collaboration with ITI institutes to attract young talent.
4. Continuously adjust and enhance employee satisfaction and retention strategies based on feedback and results.

By focusing on employee satisfaction, career development, work-life balance, and recognition, the company aims to create a positive work environment that attracts and retains skilled talent. Additionally, the collaboration with nearby ITI institutes

highlights the company's commitment to nurturing young talent and bridging the skills gap. Through ongoing monitoring, adaptation, and engagement with both current and potential employees, Karthik Engineering Works is poised to build a resilient and motivated workforce, ultimately contributing to its long-term success and growth in the competitive manufacturing industry.