Garment Manufacturing Analysis

Benjamin Abrahamsen Hagen

ABSTRACT

The purpose of this data analysis project was to gain insight into several aspects of the operation of a garment production company. This analysis examined the productivity levels of various teams and production processes, the impact of rest days on productivity, employee incentives, and the relationship between team size and productivity.

Several data visualization techniques were used in the analysis to highlight key trends and patterns in the data, including bar plots, heatmaps, and line charts. Through these visualizations, it's possible to identify possible areas for improvement and develop strategies to improve the company's performance.

Even though the analysis was able to provide some useful insights, it also highlighted the need for additional research and data in order to confirm the results. Several factors affecting productivity were found to be complex and required further investigation. For instance, while the analysis revealed that certain teams were more productive than others, it was not clear why this was the case.

It is nevertheless important to note that despite these limitations, the analysis provides a valuable starting point for developing targeted solutions in order to improve performance in the garment production company.

1 INTRODUCTION

Statistical data analysis is a critical process for businesses looking to maximize their profits. This task involves the analysis of a real-world data set from a garment manufacturing company. Our objective in this task is to answer five questions.

The first question is about the actual productivity of individual teams and which team is the most/worst productive. The second question asks which of the two garment production processes (sewing and finishing) is the hardest. The third question is about which day of the week is the rest day for workers, and how it affects their productivity. The fourth question is about when the company pays incentives to its workers and whether both sewing and finishing departments enjoy the same incentives. Finally, the fifth question is about the relationship between the number of workers in a team and the productivity of the team.

Analyzing the data and providing insights into the factors that contribute to productivity differences can help decision-makers in the garment industry develop targeted solutions to improve performance.

2 DATASET DESCRIPTION

The dataset[1] used in this analysis is a collection of real-world data that has been validated by industry experts. It includes 1197 production records, each with 15 variables that provide insights into the garment production process and the productivity of the employees involved.

The variables cover various aspects such as the date of production, day of the week, quarter, department, team number, number of workers, number of style changes, targeted productivity, standard minute value, work in progress, overtime, incentive, idle time, idle men, and actual productivity.

Overall, the dataset provides a comprehensive overview of the production process, enabling researchers to gain valuable insights into the factors that impact productivity in the garment industry.

3 DATA ANALYSIS

3.1 Question 1

Does the individual teams actual productivity exceed their targeted productivity, and which team is the most/worst productive?

In Figure 1, we can see the bar plots indicating the actual and targeted productivity for each team. According to the bar plot, teams 1, 3, and 12 have the highest actual productivity compared to their targeted productivity, while teams 5, 6, and 11 have the lowest actual productivity compared to their targeted productivity. Other teams have an actual productivity that is somewhat close to their targeted productivity.

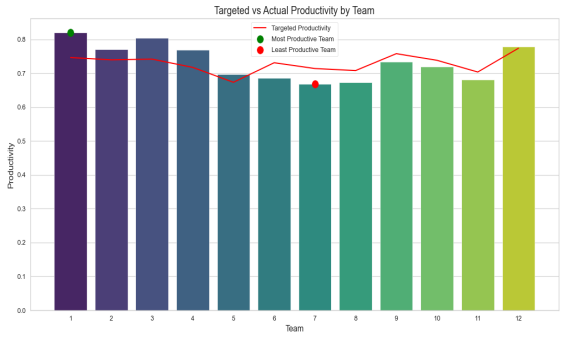

Figure 1: Actual and Targeted Productivity

However, it is important to note that the differences in actual productivity between the teams may not be statistically significant due to the fact that we do not know the variability or distribution of the productivity measures within each team. In order to determine whether the observed differences are meaningful, we must conduct a more detailed analysis.

By examining the other variables in the dataset, we can gain insights into the factors that contribute to the observed differences in productivity and develop targeted solutions to improve performance.

3.2 Question 2

Which of the two garment production processes (i.e., sewing and finishing) is the hardest?

Figure 2 shows the average performance for each department of sewing and finishing on different days of the week. Despite the fact that the heatmap can provide some useful insights into the performance of each department, it does not provide the necessary detail to determine which production process is the hardest.

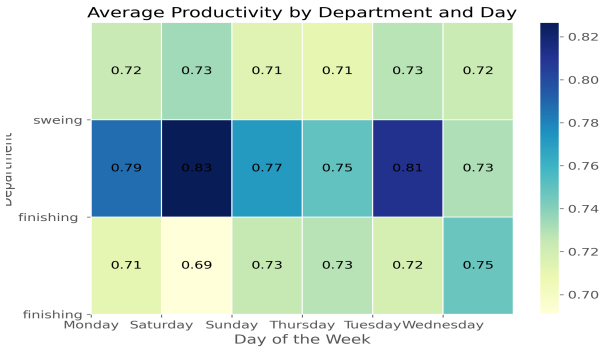

Figure 2: Heatmap Average Productivity

One observation that can be made from the heatmap is that the finishing department generally has a lower performance than the sewing department. This is particularly noticeable on Saturday, Sunday, and Thursday, where the finishing department has the lowest performance across all days. However, it is important to note that additional data would be needed to confirm whether or not the finishing department is indeed the hardest.

Furthermore, another observation from the heatmap in Figure 2 is that the performance of the finishing department has more variability across different days of the week compared to the sewing department. Unlike the sewing department, where performance is relatively consistent across all days, the finishing department is more variable, with some days performing better than others. This could indicate that the finishing department is facing more challenges, but again, this is not a conclusive conclusion and further research is necessary to confirm this.

3.3 Question 3

Which of the days is mostly the rest day for the workers and how does the resting affect their productivity afterwards?

We can assume that Friday is a day of rest for the workers since there is no data available for Friday. It is important to note that taking a rest day is important for the well-being of workers and will have a positive effect on their productivity once they return to work.

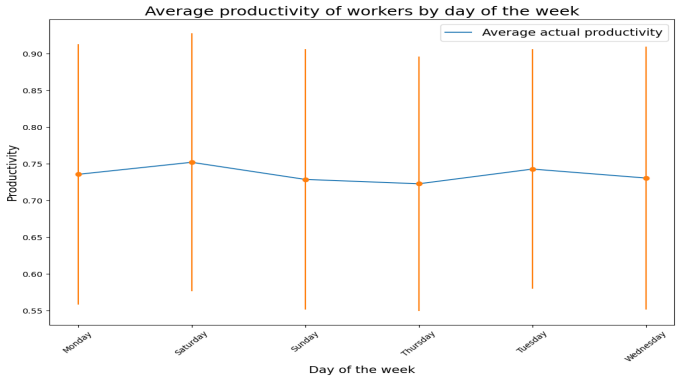

Figure 3: Line Chart

As shown in Figure 3, we can see the actual productivity against the days of the week in order to gain a better understanding of the trends and patterns in the data.
As can be seen, by the line chart, workers are most productive on Saturdays, with an actual productivity of 0.75, followed closely by Tuesdays with an actual productivity of 0.74. With 0.72, Thursdays have the lowest actual productivity, followed by Sundays with 0.72.

Interestingly, the productivity levels for each day of the week do not follow a consistent pattern. Rather, productivity levels vary from day to day. According to the line chart in Figure 3, productivity levels tend to dip during the middle of the week, with Thursdays having the lowest productivity levels.

Based on the line chart in Figure 3, we can see that workers are able to maintain their productivity levels even after taking a rest day. There is no noticeable decrease in productivity on Saturdays following a rest day on Friday. As a result, workers are able to adequately recover during their rest days, which in turn positively impacts their productivity when they return to work.

3.4 Question 4

When does the company pay more incentive to its workers? And does both sewing and finishing departments enjoy the same incentives?

Based on the data, we can conclude that the company pays incentives to its employees in both the sewing and finishing departments, however, the mean incentives differ between the two departments. We can create two bar plots to illustrate the distribution of incentives across departments and quarters.

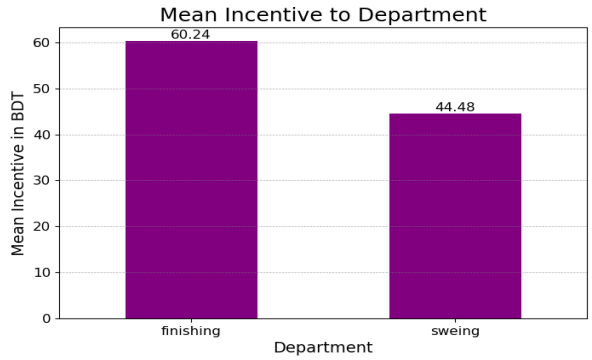

Figure 4: Mean Incentives for Each Department

Figure 4 shows the mean incentives for each department, with the height of the bars representing the mean incentive.
According to Figure 4, the mean incentive for the finishing department is 60.24, while the incentive for the sewing department is 44.48. As a result, the finishing department receives higher incentives on average than the sewing department.

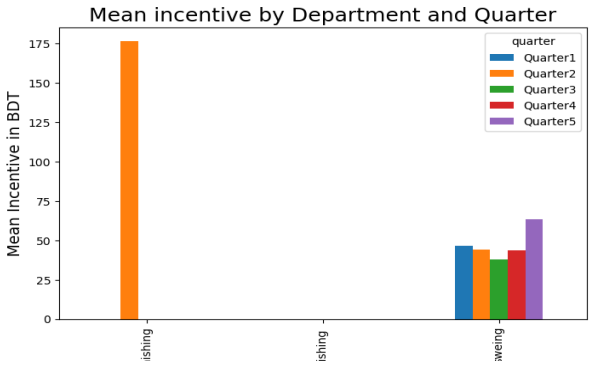

Figure 5: Mean Incentives by Department and Quarter

Figure 5 shows a bar chart depicting the mean incentives by department and quarter, with each bar representing the mean incentive for that quarter.
As shown in Figure 5, when we examine the mean incentives for departments and quarters, the finishing department only receives incentives for Quarter 2, while the sewing department receives incentives for all quarters. The mean incentive for the finishing department in Quarter 2 is 176.47, which is significantly higher than any other quarter for both departments. In contrast, the mean incentive for the sewing department varies from 37.84 in Quarter 3 to 63.48 in Quarter 5.

3.5 Question 5

How does the number of style changes impact productivity?

In the garment industry, changing the style of a product often requires reconfiguring machinery, training workers for the new style, and potentially dealing with new materials or patterns. These factors can disrupt the production flow and decrease productivity. If a strong relationship between the number of style changes and productivity is found, the company might consider strategies to minimize style changes or manage them more effectively to optimize productivity.

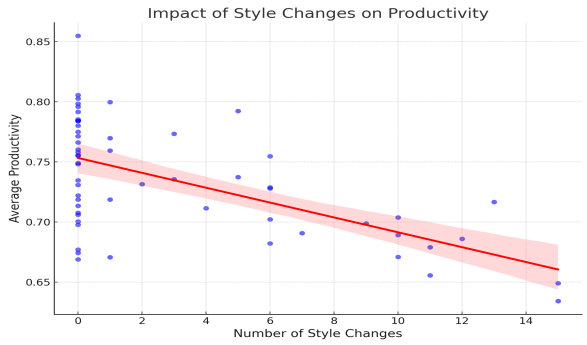

Figure 6: Casual and Registered Users Average

The scatter plot seen in Figure 6 above visualizes the relationship between the number of style changes and average productivity. Each point in the plot represents a day of operation, with the x-coordinate representing the total number of style changes that day and the y-coordinate representing the average productivity.

From the visualization and the correlation analysis, we can see that there is a negative correlation of approximately -0.58 between the number of style changes and productivity. This suggests that on days when there are more style changes, productivity tends to be lower. Conversely, on days with fewer style changes, productivity tends to be higher.
This finding is important for the garment company, as it suggests that minimizing the number of style changes could be a strategy to improve productivity. For example, the company could try to batch production runs of the same style together or improve the efficiency of style changeovers.

4 DISCUSSION

In this study, we examined a variety of factors that affect the productivity of garment production teams, such as the number of workers, rest days, incentives, and productivity levels in different departments.

Regarding the first question, we can conclude that some teams have higher actual productivity than their targeted productivity, while others have lower productivity. Without further analysis, it is not possible to determine whether the observed differences are statistically significant.

In response to the second question, the heatmap indicates that the finishing department has generally lower productivity than the sewing department, however, additional data is needed to determine whether finishing is indeed the most challenging process.

Regarding the third question, we can assume that Friday is a day of rest for workers, and that productivity levels do not decrease on Saturdays following the rest day.

According to the fourth question, the company pays incentives to workers in both the sewing and finishing departments, however, the average incentives vary between the two departments. The finishing department receives the highest incentive in Quarter 2.

In response to the fifth question, we found that the number of style changes significantly impacts productivity. There is a moderate negative correlation between the number of style changes and productivity, suggesting that days with more style changes tend to have lower productivity. This could be due to the disruptions and additional work associated with changing styles, such as reconfiguring machinery and training workers for new patterns. These findings highlight the importance of carefully managing style changes to maintain high productivity levels.

In order to draw more concrete conclusions about the factors that influence garment production productivity, additional analyses are required. The current analysis provides valuable insights into the data and trends observed, however, further research, including statistical testing, may be required to draw more definitive conclusions.

5 CONCLUSION

As a result of the analysis of the garment factory dataset, several insights have been gained regarding the company's incentive and productivity systems.
According to the analysis, some teams exceeded their target productivity levels, indicating the presence of high-performing teams within the factory.
The analysis also indicated that the finishing department had lower performance than the sewing department, although further data is required to determine conclusively which production process is the most challenging.

The analysis showed that taking a rest day was beneficial for workers' productivity, as workers were able to maintain their productivity levels after taking a day off.
Additionally, the analysis revealed that the company offers incentives to its workers, but the distribution of incentives varies by department and quarter. Therefore, it is necessary for the company to review its incentive system and ensure that it is equitable and aligned with the company's overall objectives. With the implementation of a fair and effective incentive system, the company can motivate its workers to increase their productivity and contribute to the company's success.

The analysis revealed a significant relationship between the number of style changes and productivity levels. Days with more style changes tend to have lower productivity, likely due to the complexities and additional work involved in adjusting to different styles. To enhance overall productivity, the company might consider strategies to minimize the frequency of style changes or manage them more efficiently. This could involve planning production schedules to batch similar styles together or improving the efficiency of the changeover process.

Based on the insights gained from the analysis of the garment factory dataset, the company can develop targeted strategies to improve the overall productivity of the factory and motivate workers more effectively. However, further analysis is necessary to confirm some of the observations and to identify other factors that may contribute to the factory's performance.

REFERENCES

[1] Md Shamsur Rahim, Abdullah Al Imran, and Tanvir Ahmed. 2021. Mining the Productivity Data of Garment Industry. *International Journal of Business Intelligence and Data Mining* 1, 1 (2021), 1. https://doi.org/10.1504/ijbidm.2021.10028084