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I. EXECUTIVE SUMMARY

By taking advantage of Industry 4.0's technology to transition into a digital manufacturing facility, IntelliAuto can potentially increase its industrial competitiveness by lowering costs and enhancing productivity. Nevertheless, transitioning to Industry 4.0 might raise ethical backlash for the firm, potentially resulting in employees losing jobs to robots and automation. IntelliAuto can gain a deep understanding of its employees through this descriptive analytics report to prepare for further negotiations with unions. The methodologies, findings, and recommendations are provided in this report.

II. INTRODUCTION

a. Business Background

IntelliAuto is an automotive components manufacturer that has a workforce of 5000 employees. The company's goal for the next five years is to successfully transform itself into a digital manufacturer by implementing robotics and automation of Industry 4.0. Therefore, a survey of 1000 random employees was conducted to prepare for the initial stages of the transitioning project.

b. Objective

The report's goal is to concisely answer all the questions of the Chief Human Resource Officer (CHRO) by analyzing the data using two different methods. Furthermore, the insights gained from the report are also used as preparation materials for future negotiations with unions when the organization suggests digital transformation for its factory.

III. METHODOLOGY

a. Univariate analysis

Since the number of worked hours was required to be summarized, which was only one variable, the univariate analysis was applied. Technically, the measures of central tendency (mean, mode, median) and variability (standard deviation) of the Worked Hours variable are identified using the `stat.desc` function¹². Furthermore, graphical methods are applied using the `ggplot2` package³ to chart the histogram and boxplot. With those charts, the data's locality, shape, and outliers can be easily interpreted.

¹ Belongs to package "pastecs".

² The use of `stat.desc` over `summary` function is because it can deliver more parameters for analysis.

³ `geom_boxplot` used to draw the boxplot, while `geom_hist` used to draw the histogram.

b. Bivariate analysis

Unlike univariate analysis, bivariate analysis is applied when two variables are involved, which aims to determine the statistical relationship between them (Babbie 2010). In the case of two continuous variables⁴, the statistical method (correlation coefficient) can be calculated by using the corr function to determine the relationship strength between two continuous variables and whether their relationship is positive or negative. However, if one in two variables is categorical⁵, graphical methods are applied instead: the grouped boxplot and percentage stacked bar chart. Those charts can provide a visual comparison between the median/proportion of the categorical variables on each different level of the continuous variable, thereby indicating whether there is a potential positive/negative dependency.

IV. FINDINGS

1. Overall summary of the number of hours worked.

Descriptive Statistic	Number of Worked Hours per week
Minimum	28
Maximum	89
Range	61
Median	42
Mean	45.79
Mode	40
Standard Deviation	9.68
Number of Observation	1000

Table 1: Summary of Hours Worked at the Organization.

⁴ For instance: employees' ages versus worked hours; years in the workforce versus worked hours.

⁵ For instance: employees' gender versus worked hours.

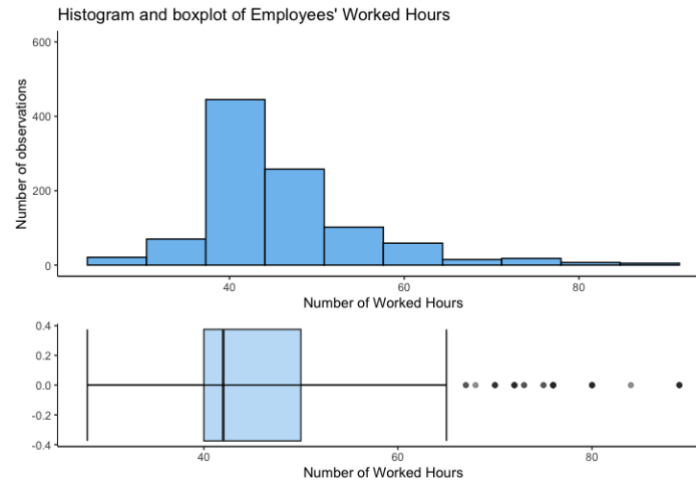


Figure 1: Histogram and boxplot illustrate the distribution of employee worked hours.

The average worked hours of the surveyed employees is 45.79 hours/week, which is slightly higher than the normal working hours of 40 hours/week (Table 1). However, the highest worked hours recorded is 89, which is more than double the normal worked hours of 40 hours per week (Mode), informing the existence of upper-bound outliers (Figure 2). Therefore, the median is better than mean in measuring the data's central tendency, as the mean is distorted by outliers. Moreover, an upper-bound outlier stretches the data distribution, causing the median less than the mean, thereby causing the shape of data to be right-skewed.

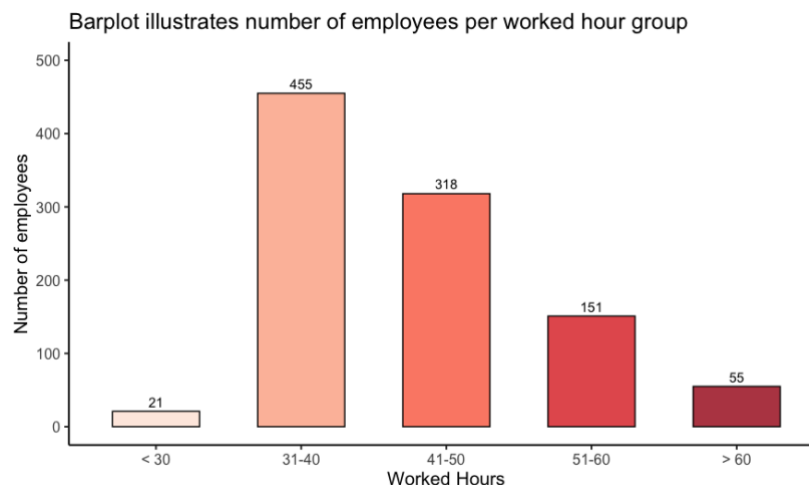


Figure 2: The bar plot illustrates number of employees per worked hour group.

There have been 55 employees working more than 60 hours a week (Figure 2). Moreover, since the company's normal working hours is 40 hours weekly, over 50% of the company's workforce is taking extra shifts (Figure 3).

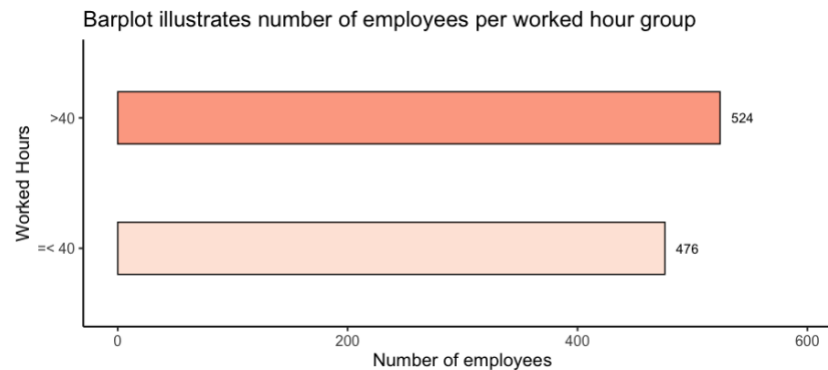


Figure 3: The bar plot illustrates the number of employee works more/less than 40 hours per week.

2. Employee groups that worked with the longest hours

a. By gender

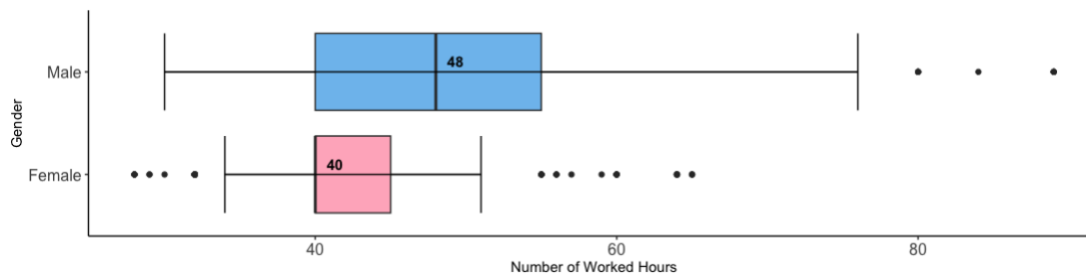


Figure 4: Box plot illustrates the difference between male and female employees in median worked hours.

With a median of 48 hours/week, male employee group had the most prolonged worked hours compared to female employee group, whose median worked hours is 40/week⁶.

b. By age

⁶Owing to outliers, median is used for comparison instead of mean.

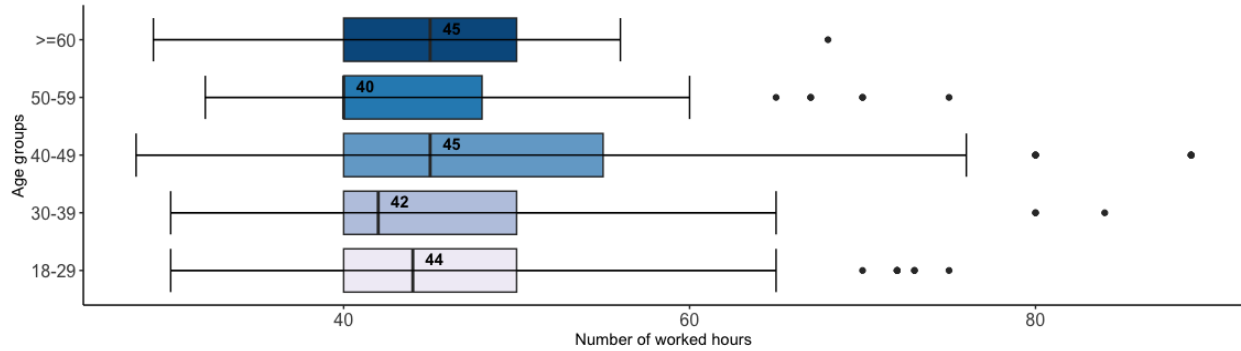


Figure 5: Box plot illustrates the difference between age groups in median worked hours.

The correlation coefficient between Worked Hours and Age
-0.0935

Table 2: Correlation coefficient between employees' worked hours and their ages.

According to Figure 4, both the 40-49 and from 60 age groups have the highest median worked hours, with medians of 45 worked hours. There is no noticeable pattern illustrated by the chart, suggesting no potential relationship between two variables. In fact, with a correlation of -0.0935 (Table 2), there is clearly no association between employees' ages and their worked hours per week.

c. By years in work force

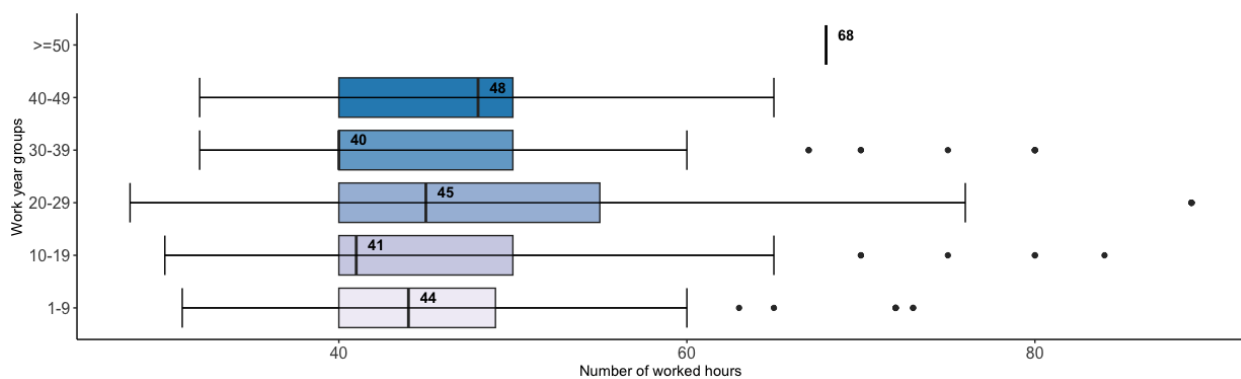


Figure 6: Box plot illustrates the difference between work year groups in median worked hours.

The correlation coefficient between Worked Hours and Years in Workforce
0.0228

Table 3: Correlation between employees' worked hours and their years in the workforce.

With a median of 68 worked hours weekly, employees who have been in the workforce for 50 (more) years have the highest worked hours per week (Figure 5). The comparison from the chart might suggest a positive relationship: the more years the employee is in the workforce, the longer hours they spend working per week. Nevertheless, the correlation coefficient between the two variables informs a negligible relationship (Table 3).

3. Female Proportion

a. By age group

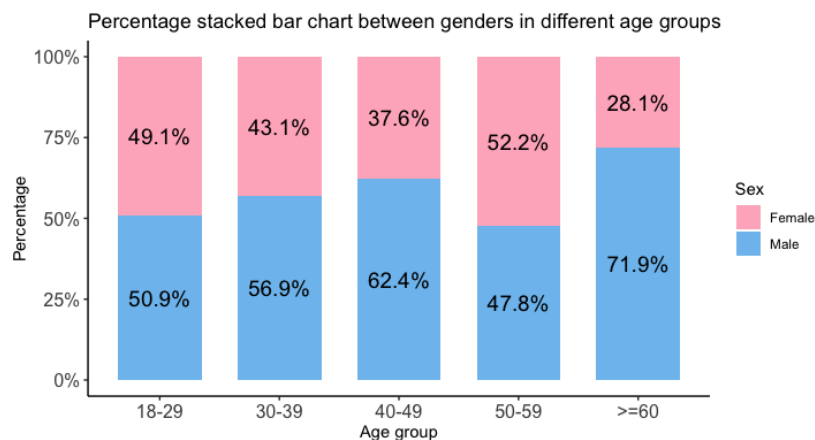


Figure 7: Percentage stacked bar hart between Male and Female employee in different age groups

The older the age group is, the lower the proportion of female employees in the age group will be, except the 50-59 age group, indicating a potential negative relationship between the number of female employees and employees' age groups (Figure 7). There is a possibility that senior men are easier to be hired by IntelliAuto than senior women.

b. By occupation

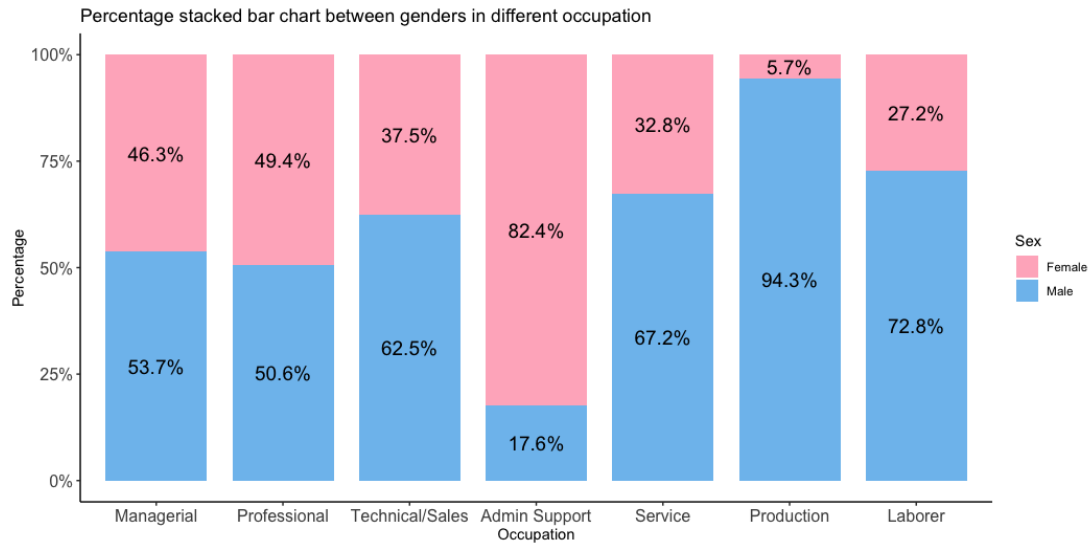


Figure 8: Proportion table between Female and Male employees in different occupation.

Overall, female employees account for less proportion than male employees in most roles, except the Admin Support, in which they account for the highest percentage: up to 82.39%. Contrastively, female workers account for the most negligible proportion in production position, which is a labor-intensive role, with only 5.59%. However, there is no significant difference between the two genders when it comes to high-skilled roles like Managerial and Professional.

c. By promotional opportunity

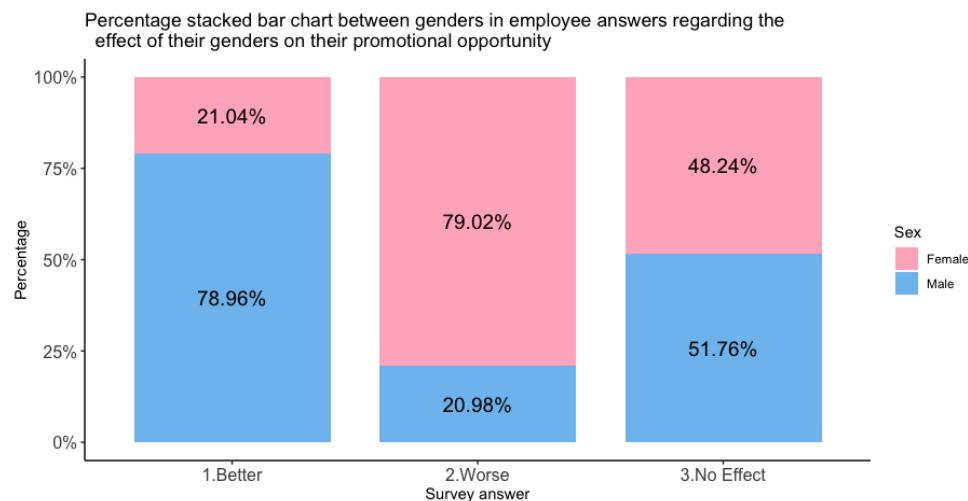


Figure 9: Percentage stacked bar chart between male and female employees' answers regarding the effect of their genders on their promotional opportunity.

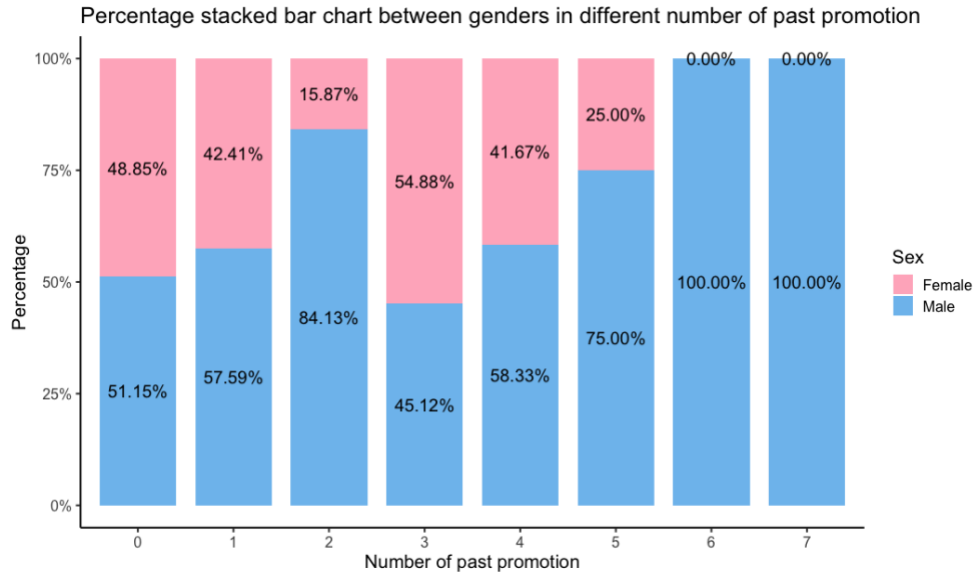


Figure 10: Percentage stacked bar chart between genders in a different number of past promotions.

Most of the female employees are pessimistic about their gender would affect their future promotion, as they account up to 70.02% of “Worse” answers, completely outweighs male employees. Contrastively, by accounting for almost 80% of “Better” answers, male employees are very optimistic that their gender would offer they better chance of having promotions (Figure 9).

In fact, there is a relationship between employees’ gender and their promotional opportunity, as Figure 10 shows that there are higher proportions of male in a higher number of past promotion groups. Furthermore, female employees are completely absent in groups 6 – 7 number of promotions, indicating that women are less likely than men to be promoted (disparity in promotion).

4. Industry 4.0 Awareness

a. Between age groups

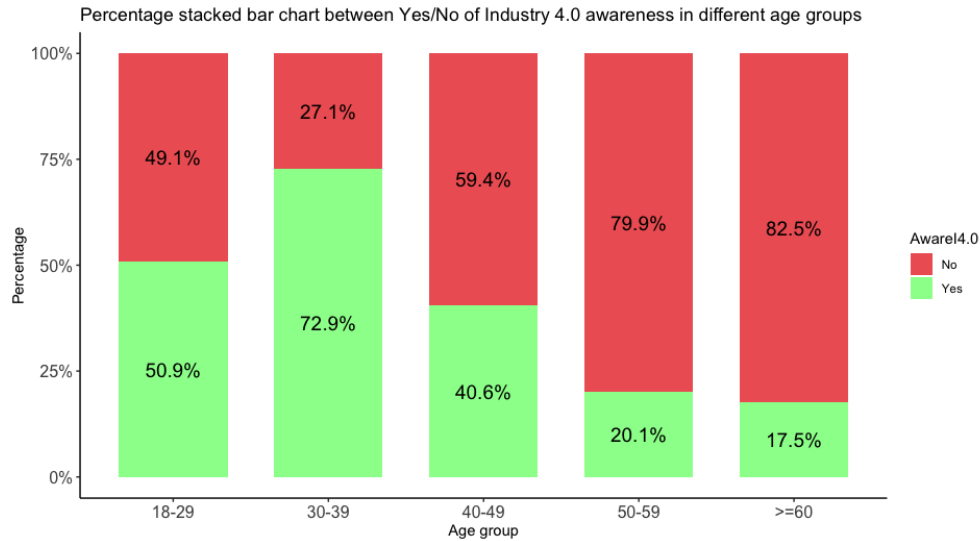


Figure 11: Percentage stacked bar chart between Yes/No of industry 4.0 awareness answers in different age groups.

With an overall declining trend of “Yes” answer proportion across the employee age groups (Figure 11), it is noticeable that the older the employee’s group is, the less they are aware about the Industry 4.0. Specifically, two youngest age groups have the highest proportion of being knowledgeable about the Industry 4.0, while the two oldest age groups have the least proportion of employees being unfamiliar with the concept.

b. Between non-union and union members

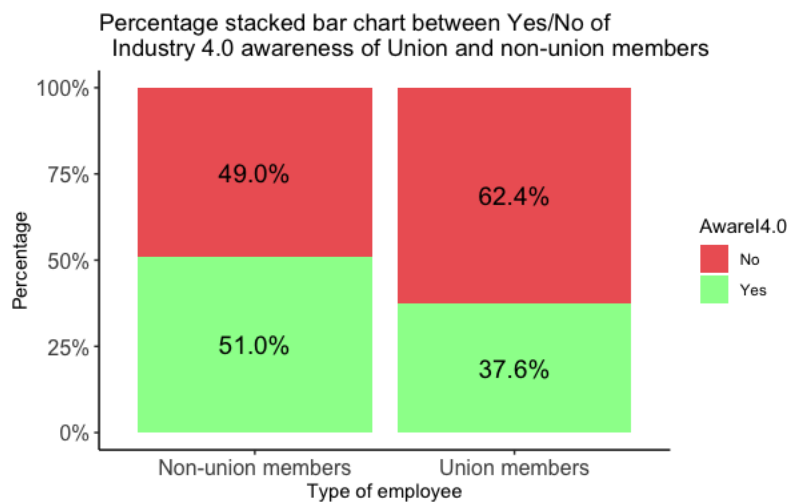


Figure 12: Percentage stacked bar chart between Yes/No of industry 4.0 awareness answer of Union and non-union members.

By accounting for more than 50% of “Yes” answers, non-union members are more informed about the Industry 4.0 than union members, who only account for approximately 40% (Figure 12).

V. DISCUSSION

1. Extreme working hours

Unfortunately, more than half of IntelliAuto’s employees is taking extra shifts to finish their assigned tasks, resulting in 55 cases of working more than 60 hours weekly, which is extremely unhealthy and risky for both workers and the company. Notably, for employees, overwork and the resulting stress not only adversely deteriorate both their physical and mental health (owing to less time spent for recovery) but also reduces their performance and work safety on the job (Rosa 1995; van der Hulst & Geurts 2001; Caruso et al. 2006). For employers, long working hours can lead to increases in absenteeism, turnover, and health insurance cost. Moreover, employers must pay more administration costs to manage overtime workers and avoid potential workplace hazards resulting from fatigue (Titopoulou et al. 2021).

2. Gender inequality

As the proportion of female employees are mostly underweighted by their male colleagues across different groups (age, occupation and promotional opportunity), IntelliAuto is facing gender inequality in their workforce. Firstly, having too few female employees might result in more males engaging over time (Figure 4), increasing men's hourly wage in return for overwork, potentially increasing the wage gap between the two genders (Cha & Weeden 2014). Secondly, women at IntelliAuto are also likely to receive fewer opportunities at work compared with men colleagues, as they are primarily allocated to fewer challenging roles (Admin Support) compared with men’s dominated roles (Managerial, Professional, Technical) (Figure 8), thereby resulting in less opportunity for women to receive professional training to have access to high-level responsibilities and tasks that are prerequisites for promotion (Lyness & Thompson 1997; De Pater et al. 2010)⁷. Lastly, the consequence of gender inequality might adversely affect the firm, from employee

⁷ As illustrated in Figure 10, men dominate the number of promotions (6 & 7) entirely.

morale, reduced productivity, losing competent female talents, to legal action against the firm (Hirsh et al. 2013).

3. Low industry 4.0 awareness among senior and union members.

The data informs that IntelliAuto's senior age group employees have a knowledge gap towards Industry 4.0, reflecting potential challenges that employees and employers must face when the transition plan starts. Particularly, the challenges came from the new technology of Industry 4.0 that elderly workers find complex and unfamiliar to work with, as they mostly have gotten used to manual and low-tech tasks from the previous industry generation (Alhlouh & Kiss 2022). Furthermore, due to low awareness, union members would try to block the firm's transition plan to protect worker jobs against robotics and automation, as they do not realise the cost and productivity benefits that the new technology would deliver.

VI. CONCLUSION

To sum up, by conducting univariate analysis of a random 1000 IntelliAuto employees, the report discovers that more than half of IntelliAuto's workforce is working long hours. Moreover, with bivariate analysis, the report also discovers that IntelliAuto is experiencing gender inequality, in which more men than women working in the workforce, and there is discrimination towards women's promotional opportunity. However, IntelliAuto already agreed with unions to contain working hours and hiring more female staffs. Lastly, the analysis also uncovers low Industry 4.0 awareness among senior employees and union members, which potentially possesses obstacles to the firm's technology transition plan.

VII. RECOMMENDATION

To solve the gender inequality phenomenon of IntelliAuto, a company that belongs to a male-dominated industry, the CHRO should develop new HR policies that provide better workplace condition for women. To attract female talents, new policies should offer flexible work patterns and schedules to support them with family responsibility, with benefit programs that provide child-care assistance and longer parental leaves. To retain competent female talents, CHRO should develop functional or management trainee programs that provide professional training, and role rotation every half year so that competent female employees can expose to different roles and functions, thereby gaining necessary experience for their future promotion. Lastly, CHRO should promote fairness in work performance evaluation.

To successfully conduct the transition plan, IntelliAuto should prepare training programs and transparent disclosure regarding Industry 4.0 towards their workforce. Particularly, the training program should be mainly for senior employees and who are not familiar with the new technology of robotics and automation. By doing that, the firm can help their labourers realize and adapt to the changes of Industry 4.0, thereby being easier for IntelliAuto to disclose new changes of new technology in labors' work. Consequently, IntelliAuto can boost both employee's and union members' Industry 4.0 awareness so that the firm can easily negotiate with them than before.

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