Assessment Submission Form

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Signed… Shane Hickey………… Date ……28/04/2018.………………

Executive Summary

This report provides an analysis and evaluation of employee attrition in ABC ltd. The major contributing factors to attrition have been identified, the department most at risk of losing employees in the near future has been identified, as well as the employees most likely to leave the company. Strategic recommendations have also been made to the company as to how we can begin to reduce the rate of attrition in the business. The methods of analysis used include data visualisation, data exploration, predictive modelling decision trees, and clustering analysis. The results of the analysis show a number of trends:

1. It is employees in the early stages of their careers who are leaving the company more so than older, more established employees.
2. Low levels of employee satisfaction are a major contributing factor as to whether employees decide to leave the company or not.
3. Low remuneration, as well as lower levels of job responsibility, are major contributing factors to employees leaving or not.
4. The requirement to travel for work in certain job roles is causing employees to leave the company.
5. The requirement to work overtime in certain job roles is causing employees to leave the company.
6. Employees who have a poor work life balance are leaving the company at a higher rate than those who have better work life balances.
7. The department most at risk of losing employees in the near future is sales, although we do not predict a significantly higher risk than the other two departments.

The report finds that the current condition of the company in terms of employee retention is not good. However, a number of strategic recommendations have been made which will contribute to a reduction in the rate of employee attrition:

1. Increase remuneration for younger workers.
2. Distribute business travel responsibilities more evenly across job roles.
3. Review overtime and annual leave policies across the company.

The analysis indicates that if these strategic recommendations are implemented, then the rate of attrition within the company will begin to fall. We are confident that if these recommendations are followed, the performance of ABC ltd in terms of employee retention can be significantly improved.

Introduction

Employee retention is a key performance indicator for human resource departments all across the world. It is a crucial indicator of the direction and the spirit within a company. If a company develops a reputation for being a toxic place to work, this will deter talent from joining a company, which will of course damage the company's commercial performance in the long run. Therefore, employee retention can be considered as a key leading indicator for the future performance of a company. Unfortunately, ABC ltd has a rate of attrition of 16% over the last number of years. This an alarmingly high rate of attrition and is something which requires immediate attention. This report has been produced by a team of Data Scientists who have been tasked with analysing data from the human resources department in an attempt to understand what the major contributors to attrition are, identify what current employees are most likely to attrite in the near future, and to outline strategic measures that ABC ltd can implement to plug this talent drain. The report begins by using data exploration and data visualisation methods to investigate the potential reasons that employees may be leaving, predictive analytics methods are then used to identify what employees are likely to leave. Finally, clustering and further data exploration is done to construct strategic methods to retain employees.

Data Exploration

This report firstly attempts to discover why employees are leaving the company. The first step involved in this is to identify what factors are highly correlated with the Attrition variable. The below picture is a visualisation of how each of the variables in the dataset are related with each other. The second row from the bottom is the row relating to Attrition, hence it is the row of interest for this report.

*Figure 1 – Heatmap of Correlations*
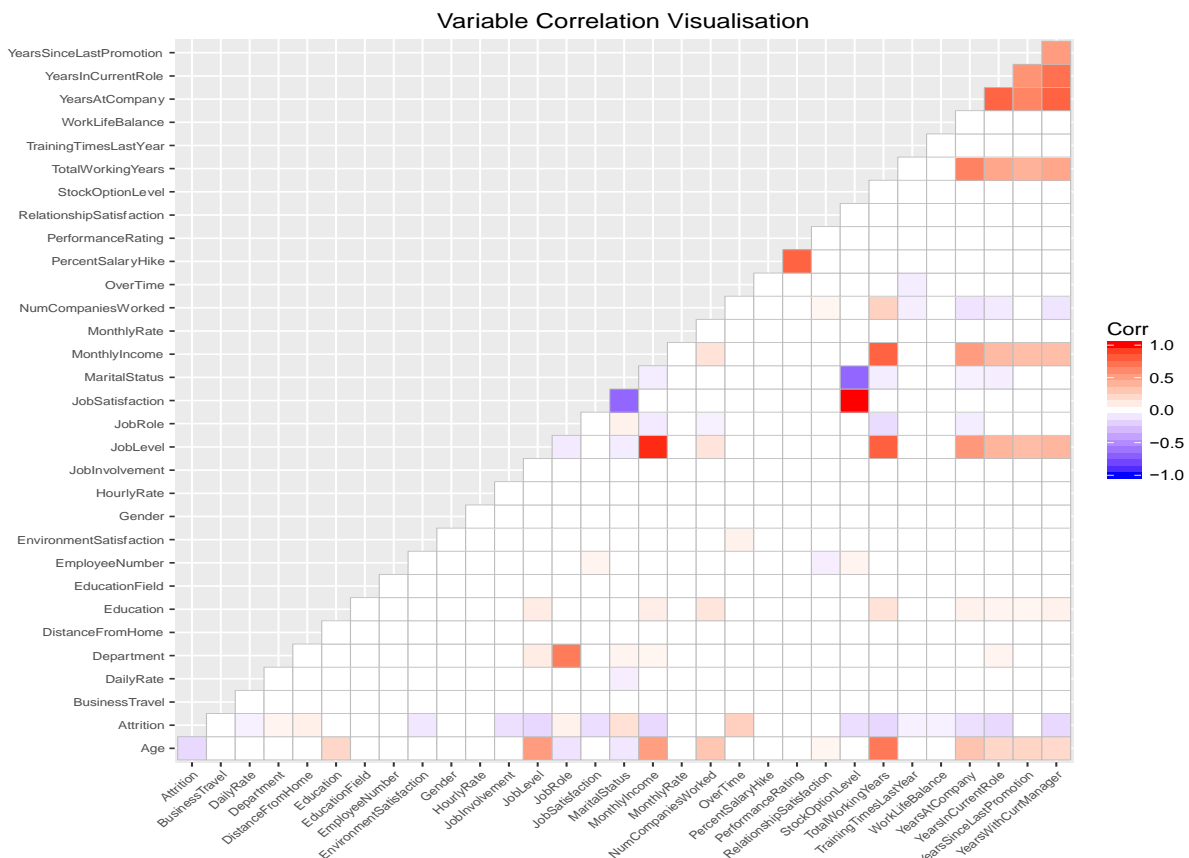
As can be seen from this row, there are a number of factors which are strongly correlated with an employee's decision to leave the company or not (Attrition). These have been highlighted in either purple (negative correlation) or red (positive correlation). These variables have been further investigated to get a better understanding of their relationship with employee attrition. The results of that investigation have been summarised below.

Employee Profile

Upon investigation of these specific variables, some worrying trends begin to appear in terms of the profile of employees who are likely to leave ABC ltd. Below is a graph of the rates of attrition per each age decile.

Figure 2 – Attrition Levels Per Age Deciles
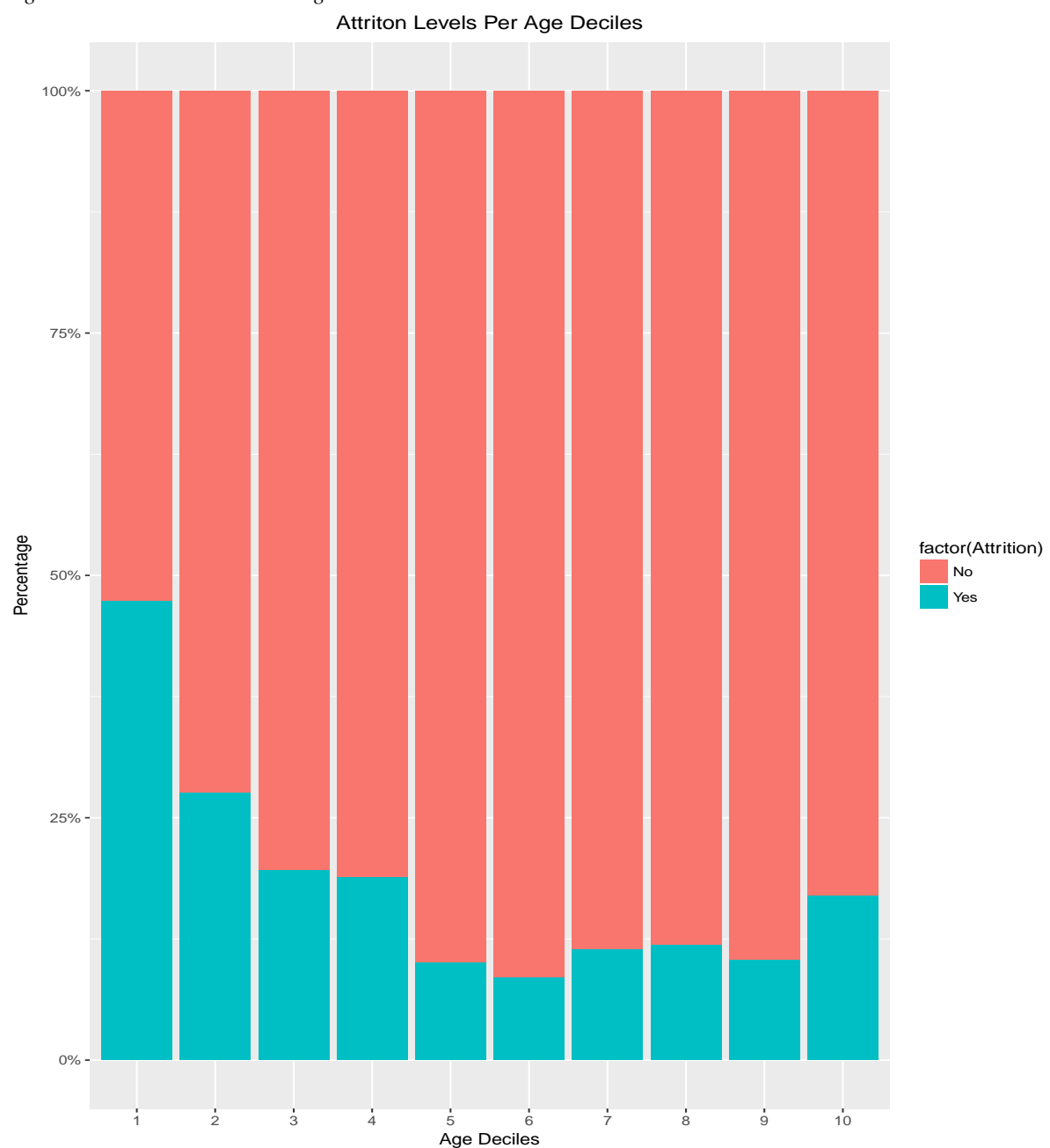
As can be seen from the graph above, there is a very clear trend that younger employees are leaving the company at a much higher rate than their older counterparts. While there appears to be a spike in the 10th decile of people leaving the company, this can probably be explained by retirement, and hence can be treated as an anomaly. Investigation of rates of attrition versus Total Working Years and Years at the Company shows an almost identical trend to one graphed above, that is employees in the early stages of their lives and careers are leaving ABC ltd at a rate of approximately 32% (Appendix 1). This paints a worrying picture for ABC ltd as a company, as it means that we are struggling to retain much of our younger workforce, which doesn't bode well for the future performance of the company.

Employee Satisfaction

The next trend which was uncovered in the exploration of the dataset was a relationship between an employee's satisfaction and their likelihood to leave ABC ltd. Below is a graph of the rates of attrition per the job involvement levels.

*Figure 3 – Attrition Rates Per Job Involvement Levels*
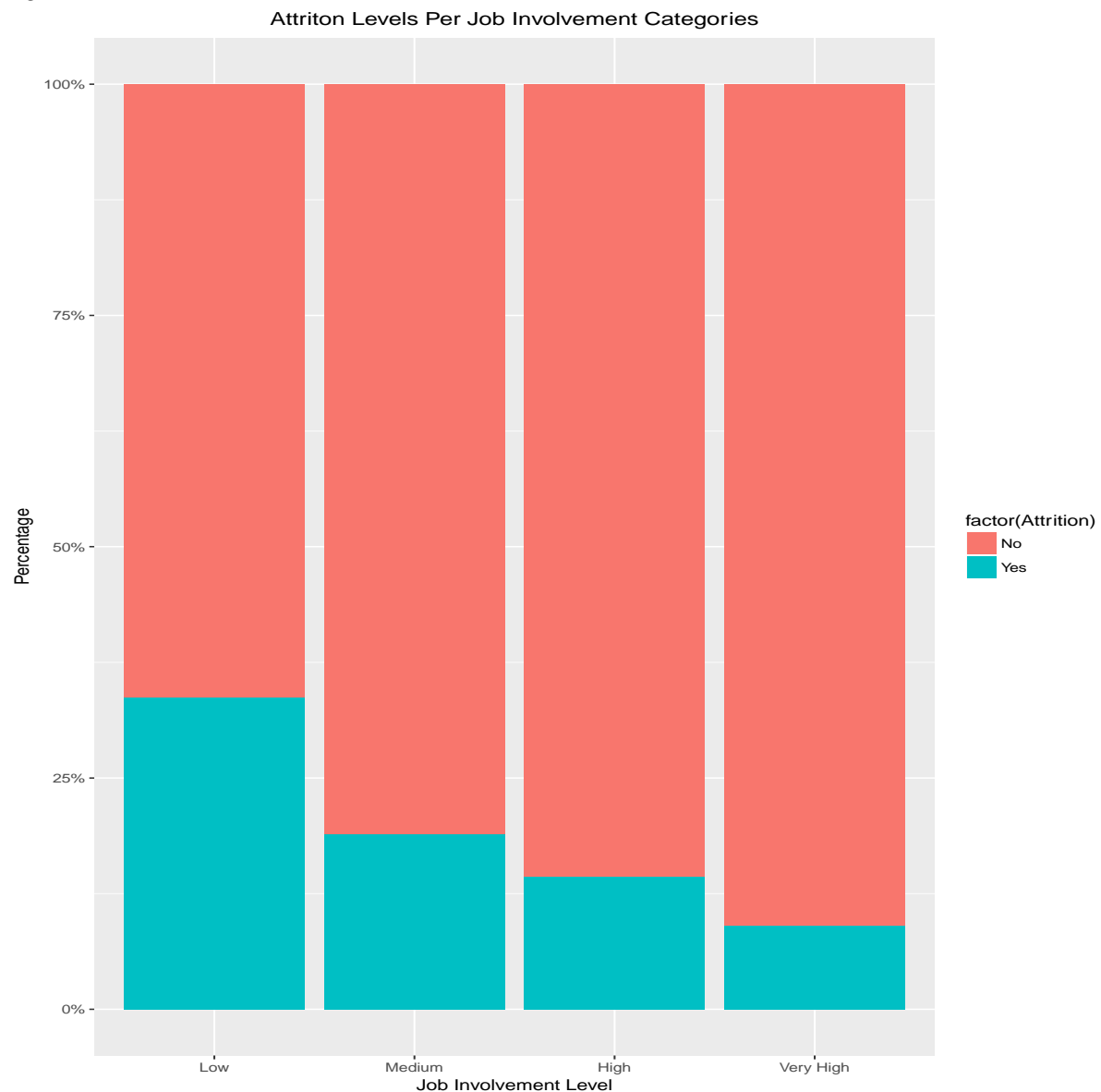
As the above graph shows, employees who rank in the lower levels of job involvement, have a significantly higher tendency to leave ABC ltd. Similar trends can be observed along the Over Time, Job Satisfaction, Environment Satisfaction and Work Life Balance variables. That is, approximately 25% of employees who feel disillusioned with their work are leaving the company (Appendix 2). While it is not surprising that employees are more likely to leave when they work over time, have a poor work life balance and poor job involvement levels etc, it is worrying that as a company we have allowed numerous employees to reach that point and feel they have no choice but to leave ABC ltd. The data now confirms that this is a real trend amongst employees, hence we must begin to implement strategies to stop employees reaching this point of disillusionment within their careers here.

Remuneration and Responsibility

The next trend to be uncovered in the exploration of the data was regarding employee remuneration and responsibility. Below is a graph showing the rate of attrition amongst the deciles of Monthly Income in the company.

Figure 4 – Attrition Rates Per Deciles of Monthly Income
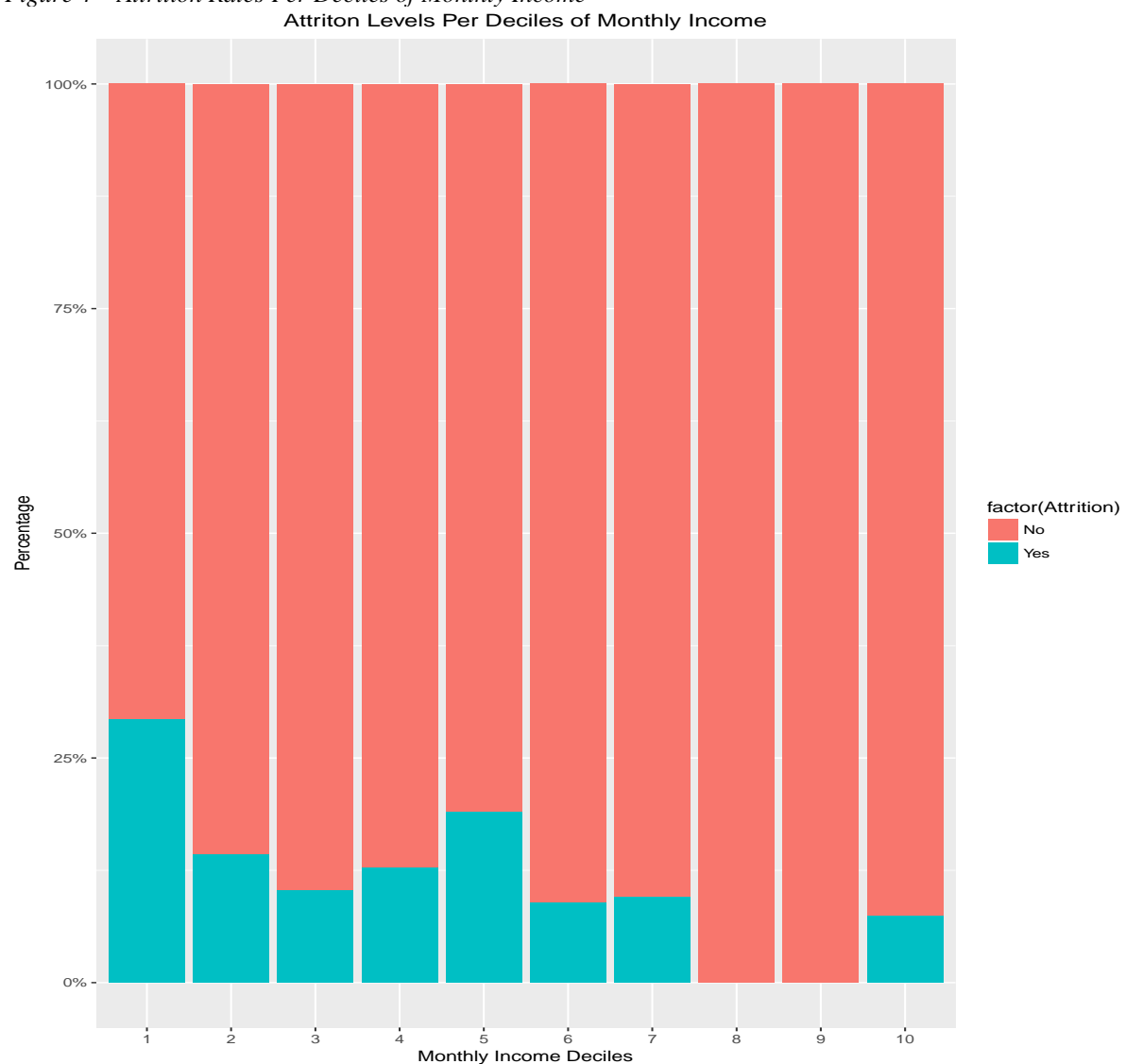
As the graph above shows, employees who are earning less money have a tendency to leave the company more than those who are earning more money. A similar trend can be seen in that employees who have less responsibility in the form of a lower job level, are more likely to leave the company. Below is a table showing the rates of attrition within each job level.

Table 3 – Rates of Attrition Per Job Level

	Job Level				
Attrition	1	2	3	4	5
Yes	*26%*	*9%*	*14%*	*5%*	*7%*
No	*74%*	*91%*	*86%*	*95%*	*93%*

As can be seen from the table of results, employees in job level 1 have a much higher rate of attrition than those in the higher levels. It is clear from this analysis that employees who are earning less money and who have less responsibility in work are significantly contributing to the rate of attrition within the company. While this trend is cause for concern, now that it has been identified, we can begin to tackle it as a company, and begin to reduce the rates of attrition.

Business Travel Analysis

Exploration of the data along deeper dimensions gives rise to some interesting information about sub groups of our employees. This information can be used to isolate these sub groups and construct strategies tailored for them to stay at the company. Below is a graph of the rates of attrition per business travel levels, grouped by job roles.

*Figure 5 – Attrition Levels per Business Travel Categories, Grouped by Job Role*

Attrition Levels Per Business Travels Categories Grouped By Job Role
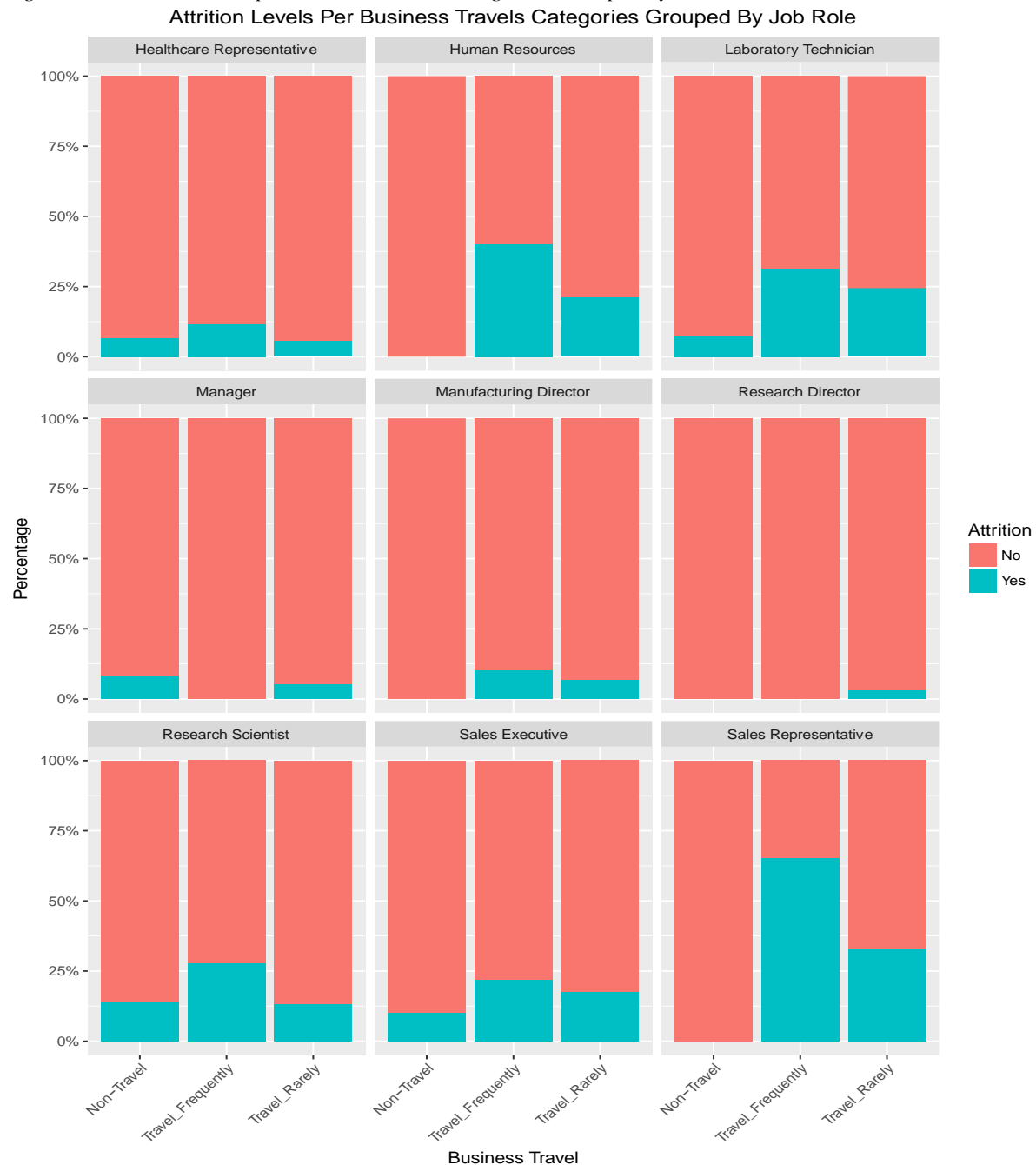
As can be seen from the graph above, there a specific sub groups of the employees who are contributing significantly to the attrition rates of the company. It is clear that Human Resource employees, Laboratory Technicians, Research Scientists, Sales Executives and Sales Representatives who travel frequently for work are leaving ABC ltd at an alarming rate. However, their colleagues who travel rarely and who are non-travellers are not leaving nearly as much. This is something which is addressed in the recommendations section.

Work Life Balance Analysis

Below is a graph which shows the rates of Attrition per the Work Life Balance categories, also grouped by Job Roles.

Figure 6 – Attrition Levels per Work Life Balance Categories, Grouped by Job Role

Attrition Levels Per Work Life Balance Categories Grouped By Job Role
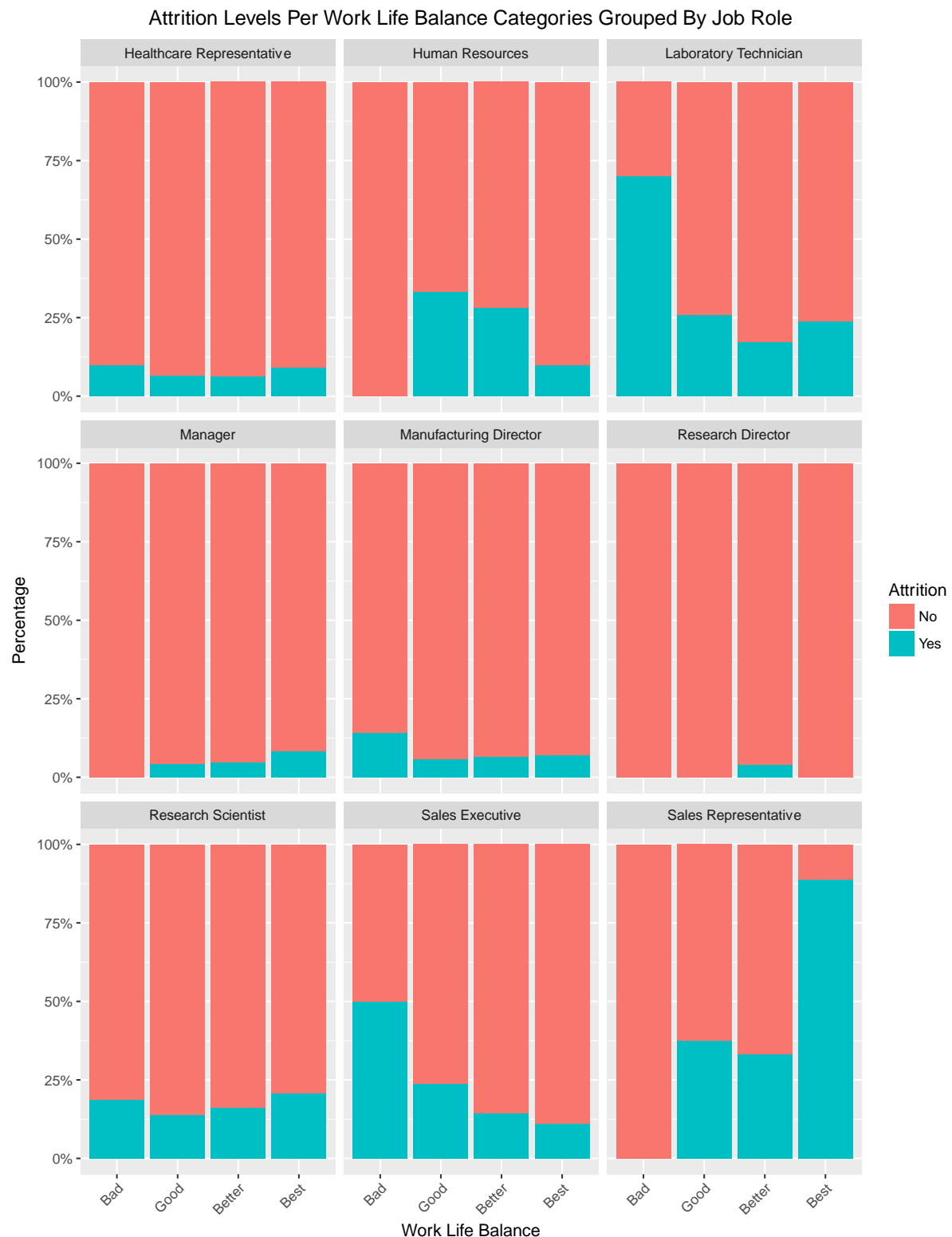
It is clear from this graph that there are more sub groups of employees within the company who are leaving at alarmingly high rates. Approximately 70% of Laboratory Technicians who have a bad work life balance are leaving the company. While not quite as high, there are a significant proportion of Sales Executives with a bad work life balance leaving the company too. Laboratory Technicians account for 17% of employees in the whole dataset, and Sales

Executives account for 22% of employees in the whole dataset. Hence this is an issue which will warrant attention in the recommendation section of this report. It is worth noting the unusually high rate of Sales Representatives with the best levels of work life balance who have left the company. This represents just 9 employees out of 1470 in the whole dataset, hence it can be treated as an outlier in the data.

Over Time Analysis

There are further trends in the subgroups of job roles and overtime. Below is a graph which shows the rate of attrition per overtime categories, grouped by job role.

Figure 7 – Attrition Levels Per Over Time Categories, Grouped by Job Role
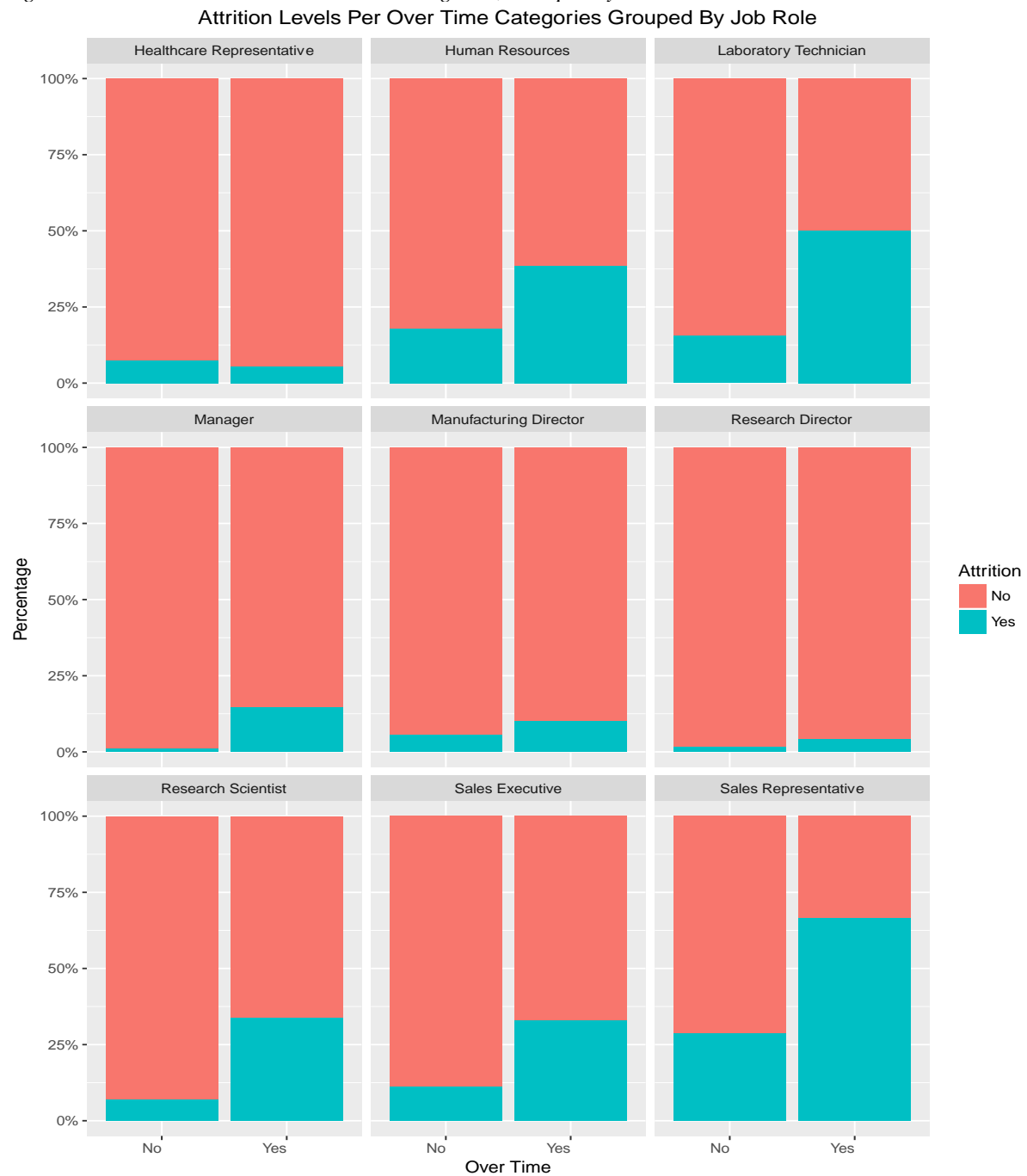
As can be seen from the graph above, Human Resource employees, Laboratory Technicians, Research Scientists, Sales Executives, and Sales Representatives who work overtime are much more likely to leave the company. This is a significant problem that is addressed in the recommendations section of this report.

Clustering analysis was performed on the dataset in order to group employees with similar attributes. This allows us to identify employees with similar behaviours and characteristics, meaning the specific needs of each group can be catered for in an attempt to reduce attrition. The below graph shows the results of a cluster analysis performed on the dataset along the Monthly Income, Age, and Job Level attributes.

Figure 8 – Clustering on Monthly Income, Age and Job Level
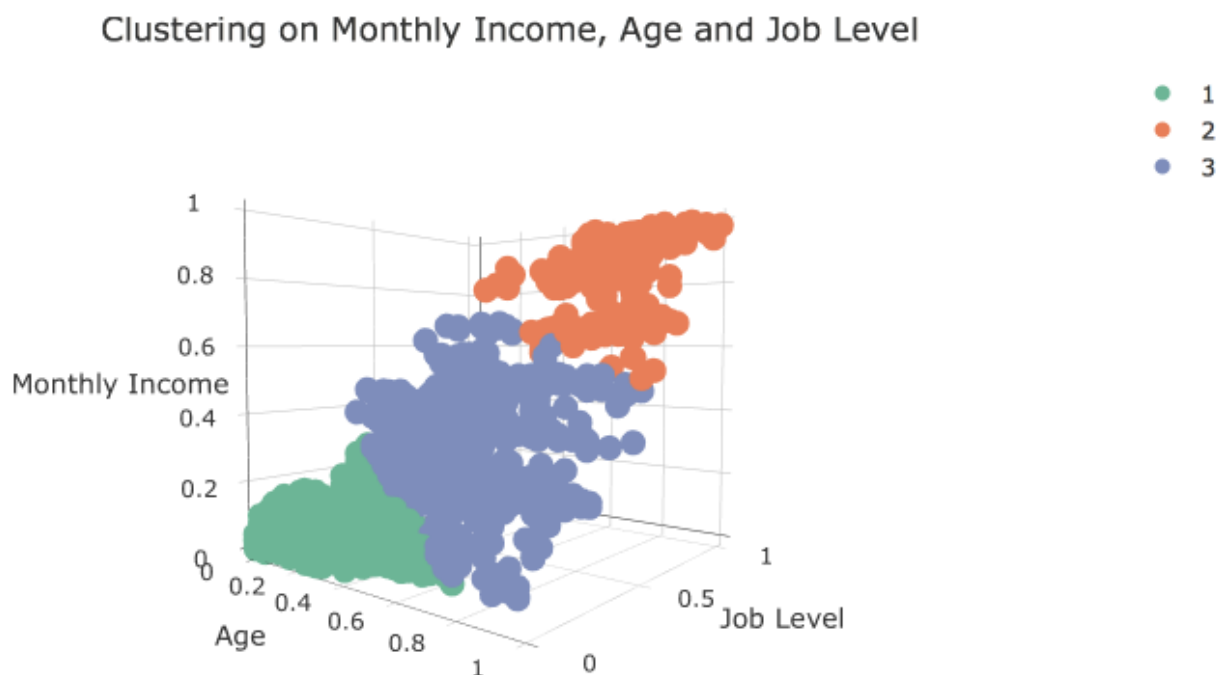
As can be seen from the graph above, there are 3 distinct natural clusters of employees when cluster analysis is performed on the dataset. Based on the earlier exploration that was performed on the dataset, we would expect cluster 1, those on a lower monthly income, younger and with a lower job level, to be the ones most likely to attrite from the company. Analysis on the rates of attrition confirms this to be the case.

Table 4 – Attrition Rates Amongst Clusters

Attrition	**Cluster 1**	**Cluster 2**	**Cluster 3**
Yes	23.46%	12.24%	5.49%
No	76.54%	87.76%	94.51%

As the results in the table above show, employees who fall into Cluster 1 are the employees who are most likely to leave the company. Ideally, these employees could be targeted and treated appropriately so as to move them from Cluster 1 into Cluster 2 or Cluster 3. This is addressed in the recommendations section of this report.

Predictive Modelling

The data science team used predictive modelling techniques to identify current employees whose data indicates that they are likely to leave the company. This predictive modelling is done by building a model based on approximately 70% to 80% of the dataset available to us. The model is told explicitly that we are trying to predict the variable attrition. Hence it learns rules from the training dataset regarding what values of all the other variables make an employee likely to stay or to leave. These rules are then collectively applied in the form of a model to the 20% or 30% of data that has not been used for training it and its performance on that testing dataset is assessed to determine the usability of that model. A number of models were developed and tested during this predictive modelling phase. The model that performed the best and which was ultimately used for predicting what employees are likely to leave had a classification accuracy score of 88.77%. A method known as 5-fold validation was used to validate the accuracy of this test score. This is when the dataset is split up into $1/5^{th}$s, 5 predictive models are then developed, each time using a different $1/5^{th}$ as the testing set. The accuracy of each model is recorded, an average accuracy is then calculated. This 88.77% accuracy is that average accuracy. The benefits of this are twofold: firstly, it gives a much fairer reflection of the accuracy of the model as it mitigates the risk of getting an unusually easy to forecast test set which would give a falsely high accuracy for the model. Secondly, because all of the data has been used as the test set at some point, it means that attrition predictions exist for every employee in the dataset. This allows for more comprehensive forecasting of what employees will leave the company.

The predictive model forecasts that there are 61 current employees who are likely to leave in the near future. The breakdown per department is as follows:

- Human Resources: 2
- Sales: 20
- R&D: 39

This can be represented as a proportion of current employees in each of those departments:

- Human Resources: 3.92%
- Sales: 5.64%
- R&D: 4.7%

Below is a table summarising the historical trends of attrition in each of the departments.

Table 4 – Historical Rates of Attrition Per Department

	Human Resources	**R&D**	**Sales**
Yes	19%	14%	21%
No	81%	86%	79%

It is clear from this analysis that the Sales department is the department most at risk of losing their current employees, although it is not significantly higher than the other two departments. The historic analysis shown in the table above show that Sales has the highest rate of attrition of all the departments, albeit marginally so. Hence it is unsurprising that it is the department predicted to lose the highest proportion of their staff due to attrition. A list of employee numbers who the model forecasts as likely to leave has been added to the appendix for your information (Appendix 3).

Of course, this model cannot predict the future completely, but it does it provide guidance on what the most important factors contributing to employee's decision to leave are. The list is as follows:

- Age
- Business Travel
- Education Field
- Environment Satisfaction
- Job Involvement
- Job Level
- Job Role
- Job Satisfaction
- Monthly Income
- Monthly Rate
- Number of Companies Worked
- Over Time
- Percent Salary Hike
- Stock Option Level
- Total Working Years
- Training Times Last Year
- Work Life Balance
- Years at Company
- Years in Current Role
- Years with Current Manager

Knowing that these factors are the major contributors to employee's leaving or staying will be useful in the construction of strategies in the recommendations section.

Recommendations

It is clear from the results of the analysis laid out in this report thus far, that ABC ltd are failing to sufficiently cater for the needs of certain groups and sub groups of employees in the company. It is because of this failure that we have an attrition rate of 16%, hence the strategic recommendations in this section centre around improving working conditions of the groups and subgroups of employees who have been identified as likely to leave, in the hope that we can reduce the rate of attrition in the company.

Recommendation 1 – Increase Remuneration for Younger Workers.

It is clear from the Employee Profile analysis, as well as the results from the clustering analysis, that ABC ltd are failing to serve the needs of our younger work force. The analysis thus far has shown that it is younger workers, in the early stages of their careers who are leaving the company at an alarmingly high rate. One can conclude from this that these workers are finding more attractive working opportunities in other companies. As a result, the first strategic recommendation that we make is to improve the remuneration that is paid to younger workers in the company, as well as giving them increased responsibility sooner, i.e. a higher job level. If this advice is followed, we are confident that many of the workers will move from Cluster 1 into Cluster 2, and therefore will be much less inclined to attrite from the company. There may of course be concerns around giving young workers too much money too early, in case they don't perform sufficiently. However, we must show faith in our hiring practices and have the confidence that if they are good enough to be hired, then they

are good enough for investment in terms of higher monthly income and more responsibility on the job.

Recommendation 2 – Distribute Business Travel More Evenly

The Business Travel analysis section highlighted a trend for some sub groups of workers to attrite from the company more than others. It is clear that Human Resource employees, Laboratory Technicians, and Sales Representatives who travel frequently are contributing significantly to the company's high rate of attrition. However, their colleagues who travel rarely and don't travel at all, have comparably low rates of attrition. Therefore, we recommend that the travelling duties be distributed more evenly amongst all employees in these job roles. Should this be done in a fair and transparent way, we are confident that the majority of workers in these job roles can all fall into the travel rarely category. This will reduce the rate of attrition for the company.

Recommendation 3 – Review Overtime and Annual Leave Policies

The Work Life Balance analysis and the Over Time analysis showed that over working employees in certain job roles is having a detrimental effect on their happiness in the company, which is contributing to the high rate of attrition. It has been shown that Laboratory Technicians, Sales Representatives, Sales Executives, Research Scientists, and Human Resource employees who have a poor work life balance and who work overtime are much more likely to attrite from the company than those who have a better work life balance and who do not work overtime. Hence it can be concluded that employees who work too much and don't have much time for any other aspects of their life are the ones who are leaving the company. Therefore, we recommend that ABC ltd have a complete root and branch review of their overtime and annual leave policies. Forcing the employees to work less overtime and giving them more annual leave to focus on activities outside of work will lead to an overall much happier work force. This will reduce the rate of attrition across the company.

Conclusion

This report has successfully highlighted the major contributors to employee attrition in the company. We have identified what departments are most at risk of losing their employees, as well as identifying who those employees are. Finally, through data exploration and clustering analysis, we have been able to make strategic recommendations which, if followed, will reduce the rate of attrition in ABC ltd. While the current situation is not ideal, we are confident, based on analysis of the dataset, that ABC ltd can begin to make the necessary steps to improve working conditions for all employees in the business and begin to increase our rate of employee retention.

Appendix

Appendix 1 – Table of Attrition Per Total Working Years Deciles

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th
Yes	*33%*	*18%*	*12%*	*10%*	*10%*	*8%*	*6%*	*2%*	*9%*	*28%*
No	*67%*	*82%*	*88%*	*90%*	*90%*	*92%*	*94%*	*98%*	*91%*	*72%*

Appendix 2 – Table of Attrition Per Levels of Environment Satisfaction

	Low	Medium	High	Very High
Yes	*25%*	*15%*	*14%*	*13%*
No	*75%*	*85%*	*86%*	*87%*

Appendix 3 – List of Employee Numbers Identified as Likely to Leave

691, 1585, 404, 1768, 441, 872, 1119, 316, 939, 311, 330, 1651, 38, 1760, 653,
1025, 1212, 549, 176, 2060, 1061, 397, 568, 1006, 238, 1303, 1120, 564, 304, 1995,
1269, 1425, 1678, 1974, 1973, 2013, 206, 901, 560, 508, 1516, 852, 337, 1195, 1992,
764, 1152, 604, 1824, 686, 154, 244, 1724, 1764, 1250, 134, 1827, 1772, 1816, 1922, 1085