



Analysis of the Intrinsic Structure of Employee Attrition and Performance

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Abstract. Turnover rate has always been an important indicator used by enterprises to measure the internal flow of human resources, through the examination of the turnover rate, we can understand the attraction and satisfaction of employees. A high turnover rate generally indicates that the company's employees are more volatile, serious conflicts happened in labor-management relations, and may cause the cohesiveness of the company is reduced, which can lead to an increase in human resources costs and a decrease in the efficiency of the organization. However, it does not mean that the lower the employee turnover rate is the better. In the market competition, maintaining a certain amount of employee turnover can enable the enterprise to use the competitive system of talent competition to keep the vitality and innovation of the enterprise. The purpose of this article is to analyze the data on turnover rates from a variety of perspectives in order to provide better advice at the level of managing the company or at the level of employee career planning.

Keywords: factor analysis · data mining · attrition rate · job satisfaction

1 Introduction

With the acceleration of world integration and economic globalization and the rapid development of information technology, the focus of global competition has shifted from material resources to soft resources such as talents, science and technology, information and human capital. The shortage of high-tech knowledge talents has been a common problem in today's world for a long time, so how to strengthen the development of talent resources, create a good environment for talent entrepreneurship, so as to attract and retain talents is the top priority of any enterprise [1]. At present, the competition for talents is becoming more and more fierce. Enterprises hope to recruit, train, use and retain talents in various ways to maximize the role of talents. In a number of industries, to prevent the brain drain, reduce the cost of recruitment, has become a top priority for many enterprises [2].

Turnover intention is defined as the behavioral tendency of an employee to give up the current job or leave the job and the organization [3], which is also an important basis to

measure whether an individual will really quit. The suddenly quit of any core employee in a company might lead serious consequence, even it doesn't happen, the adaption of new employees is also a tough process to go through for other employees in the same department. Employees in a way. While there is no direct way to stop employees from leaving, companies can try different measures to make employees change their decision to leave as much as possible. Through the use of advanced data analysis models, companies can accurately understand the reasons for employee turnover. In this case, it is no longer necessary to take corresponding measures for the dismissal of every employee, but to respond to the needs of employees from a macro level to reduce the overall dismissal rate.

In this research, we are going to investigate 31 variables' interrelationship and how they related to attrition rate with the use of factor analysis which is a fantastic method for researchers to study behavioral phenomena in a complex and diverse scenario [4]. Then, with the flexible use of comparative analysis [5] and ANOVA [6], to better investigate the effects of different variables on attrition. Many people might believe that how people satisfy about their work have great influence on this their decision about to quit. In some more detailed studies, it shows that behavior-based was the only form of conflict significantly related to job satisfaction.

2 Correlation Analysis

2.1 Exploratory Data Analysis

For employers, one of the most important factors to decide whether hire an employee or not is job involvement, which is strong evidence that shows if the employee really make profit to company. First part of Table 1 shows how two variables, which are monthly income and relationship satisfaction, influence to job involvement. Both these two combinations of variables have P-value of larger than 0.5, which shows they both aren't predominant factors of job involvement. It's clear that monthly income and job involvement shows a strong positive correlation. Although the percentage of employees that get 4 in job involvement are similar among different income stage, it's clear that more employees get 3 or better score in job involvement with higher salary, but such a tendency is not too significant. For example, the percentage different is only 2% for people have 3 or 4 in job involvement between employees earn 3000–6000 and who earn 18000–20000.

2.2 Linear Regression

Using binary regression analysis [7] to predict attrition $Y_i \in \mathcal{Y} = \{0, 1\}$ where 0 means the sample does not quit the job and 1 represents that the sample quit the job. As shown in Table 2, 17 variables are used as input for the regression analysis and finally get a 74.9% accuracy rate.

From Table 3, the variables component of model shows the significance of every variable. As shown above, every variable listed here are strongly related to attrition. In addition to the time-related factors mentioned above, some new variables, such as age,

Table 1. Classification table

Job Involvement					
Monthly income	1	2	3	4	Total
1000–3000	22	100	233	40	395
3001–6000	28	124	313	54	519
6001–9000	14	59	126	24	223
9001–12000	10	43	78	7	138
12001–15000	3	19	31	9	62
15001–18000	1	13	44	6	64
18001–20000	5	17	43	4	69
Total	83	375	868	144	1470
Relationship satisfaction					
1	17	73	157	29	276
2	18	85	176	24	303
3	25	115	276	43	459
4	23	102	259	48	432
Total	83	375	868	144	1470

Table 2. Classification table

Observed		0	1	Correct rate
Attrition	0	954	279	77.4%
	1	90	147	62.0%
Overall Percent				74.9%

environmental satisfaction and job satisfaction, also play a decisive role in the attrition decision.

First of all, age plays a decisive role in the attrition decision, and the coefficient of age is negative, which means that the older the employee is, the more reluctant he/she is to quit. It also means that young workers, especially recent graduates, have a greater chance of quitting. It is quite obvious that young workers are more likely to look for a job they like, so they will change jobs frequently. Older employees often already have deep knowledge and connections in a certain industry or company, so they are often reluctant to give up these resources to find a new job. This is a very useful phenomenon for employers, which means that employers should not give important work to younger employees, as this often comes with the risk of key people leaving mid-project. In contrast, older employees can provide security for the stability and risks of the company’s projects.

Table 3. Variables in the Equation

VARIABLES	B	S.E.	Wald	Df	Sig.	Exp(B)
Age	-0.039	0.010	14.189	1	0.000	0.962
Enviro Satisfaction	-0.294	0.070	17.576	1	0.000	0.745
Job Involvement	-0.500	0.106	22.100	1	0.000	0.606
Job Satisfaction	-0.296	0.070	17.888	1	0.000	0.744
Monthly Income	-0.313	0.081	15.019	1	0.000	0.731
Num of co. worked	0.113	0.032	12.549	1	0.000	1.119
Rela satisfaction	-0.147	0.072	4.236	1	0.040	0.863
Stock Option Level	-0.501	0.103	23.494	1	0.000	0.606
Train Time Last Yr	-0.158	0.062	6.593	1	0.010	0.854
Work Balance	-0.243	0.106	5.291	1	0.021	0.784
Yrs in Cur Role	-0.097	0.038	6.686	1	0.010	0.907
Yrs Sin Lst Promo	0.165	0.034	23.242	1	0.000	1.180
Yrs With Cr Mang	-0.096	0.037	6.722	1	0.010	0.909
Constant	4.858	0.685	54.459	1	0.000	128.776

Secondly, environmental satisfaction and job satisfaction also play a decisive role in the decision to quit. That means employers have other ways to prevent brain drain than by raising wages. The purpose of employees' work is essentially for a better life. If the company can provide employees with satisfactory work and environment, it is still possible for the company to retain employees even though the salary is lower than the market average.

Besides that, relationship satisfaction doesn't hold a high significance as expected. It's once been proposed that relationship among colleagues is an important factor for communication and thus influences feeling in the company, which will finally lead to attrition. But according to the analysis, the relationship doesn't have as most significance as most off other factors. It may be explained by the better management and ways of communication. With a better managing strategy and communication tool, such as email, Todesk, or Dingding, employees could avoid most of factors that might leads to failed communication. As a result, relationship satisfaction's significance decrease (Table 4).

The Pearson chi-square gives a accumulative significance of 0.000, which indicates a strong correlations between these two variables. With the increase of years in the company, the time to the last promotion increases significantly and the number of promotion decreases significantly. According to the data, the first concentrated promotion opportunity in the company is concentrated in one to two years, which may be because during this period, the new employee has completed the internship period, the period of running-in with the team is finished, and can start to make a real contribution to the company. Peak is the fifth year after joining the company. Employees who have been in the company for more than five years can generally be referred to as senior employees.

Table 4. Pearson Chi-square Test

	Num.	Variance.	Accumulative significance
Pearson chi-square	3900.505	540	0.000
Likelihood ratio	1926.891	540	0.000
Linear relationship	561.789	1	0.000
Effective case	1470		

At this time, employees generally have mastered job-related knowledge and gradually become familiar with the business. They begin to be assigned core work content by the company, which leads to the second peak period of promotion.

The number of promotions drops sharply when companies are more than 10 years old, and most promotions occur four to six years earlier, during the second peak promotion period mentioned above. In this period, the company has fully understood a person's ability and had a clear mind of his or her good field and suitable position, so the position of the employee will not be adjusted.

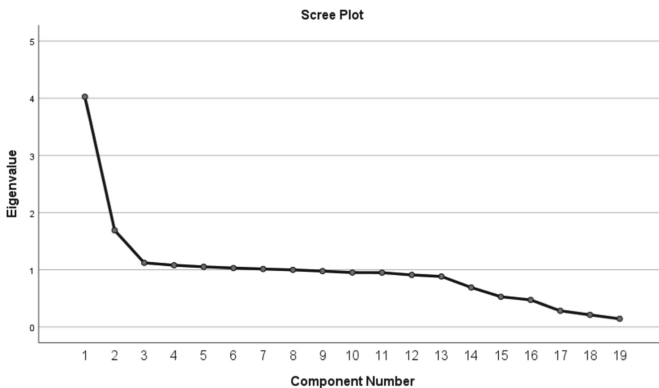
This data is very instructive for employees. Employees should consider preparing themselves for a promotion in the first five to six years or so, as this is the time when the chances of promotion are highest and may well be the last. Similarly, employees who have been with the same company for more than 10 years and haven't landed their dream position can also start thinking about moving on.

The relationship between the two variables relationship satisfaction and job involvement, job involvement shows an increase trend as the relationship satisfaction level increase. To be more specific, the percentage difference is 9% for people have 2 or 4 in job involvement between employees have 4 satisfactions in relationship and those who have 3 in relationship satisfaction. And it also suggests that companies should focus more on building relationship between colleagues rather than increase salary. A better relationship might promote employees focus more in work. Employees have the greatest chance to improve their salary at the 5–6 years after entering the company. And this chance drops significantly after staying at one company for more than 10 years. Which gives the employees the same suggestion about career life planning strategy.

Also, employees working for fewer than two companies tend to have the lowest wage (less than 6% of high earners), while the percentage of high earners (15,001+) working for more than two companies flattens out (about 11%). Many employees worry that frequent job-hopping will affect their development in the new company. After all, it will take time to get used to the new team, and it will cause problems for their integrity. However, this data shows that such concerns are completely unfounded. This may be because the vast majority of job-changers, despite changing companies, are still in similar jobs, or at least in the same major, so it doesn't take much time to get started, and the experience at the previous company often brings new ideas and performance to the new company. In addition, having been hired by multiple companies proves an employee's excellent working ability, which is often the dream of many enterprises.

Table 5. Kaiser-Meyer-Olkin and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.770
Bartlett's Test of Sphericity	Approx. Chi-Square	8192.362
	df	190
	Sig.	0.000

**Fig. 1.** Scree Plot for the Component

2.3 Factor Analysis

Factor analysis is used data to explain the correlation between individual variables and the explanatory effect on the predictive model. Kaiser-Meyer-Olkin (KMO) [8] and Bartlett's Test [9] are used to test the correlation between variables. From Table 5, the value of KMO is $0.770 > 0.5$, which shows that the presence of a partial correlation, which is plausible to conduct factor analysis, indicates that the degree of information among the variables overlaps. In addition, The correlation matrix's identity as an identity matrix is tested using the Bartlett's test of sphericity. If the same correlation matrix is produced, the variables are unrelated and the factor analysis cannot be performed. Table 5 shows the $p\text{-value} = 0.000 < 0.005$, which significantly reveals that the correlation matrix is not an identity matrix and able to do the following factor analysis.

The scree plot measures how well each principal component accounts for the volatility in the data [10]. The number of relevant components or factors can be determined with the aid of data and results from different methods of component selection. According to Fig. 1, the screen test result shows that when there are more than eight main components, variations in the feature root's overall information tend to stabilize, making it reasonable to extract eight principal components.

The Table 5 shows that among the 21 variables, the first 8 factors explain 64.371% of the dataset. Each extracted factor has its own variance contribution rate, which can reflect the extent to which the factor explains all the original variables. The contribution rate of accumulative activity is the sum of the information extracted from the original variable

Table 6. Total Variance Explained

Initial Eigenvalues				Rotation sums of squared load		
CP	Total	% of Var	Cum %	Total	% of Var	Cum %
1	4.027	20.134	20.134	3.522	17.608	17.608
2	1.796	8.982	29.116	2.176	10.879	28.486
3	1.679	5.503	37.509	1.777	8.886	37.373
4	1.101	5.503	43.012	1.045	5.223	42.569
5	1.061	5.305	48.317	1.044	5.219	53.026
6	1.050	5.249	53.566	1.042	5.212	53.026
7	1.029	5.145	58.711	1.038	5.192	58.218
8	1.012	5.062	63.733	1.031	5.153	63.371

by all factors. As can be seen from the figure, the interpretation of the first factor is the strongest, reaching 4.027. Secondly, the interpretation of the second and third factors is close, between 1.6 and 1.75. Starting from the fourth factor, the explanatory power becomes significantly weaker, around 1. Factors were cut with an explanatory value of 1 as the boundary, and 8 factors were retained. The explanatory value of these 8 factors to the original data set reached 63.371%, and they could be analyzed as strongly correlated factors (Table 7).

Table 6 shows the components of every factor. By analyzing this graph, it's easy to see the most important variables in this data set are more or less time related.

For employees, time is an important consideration in making every decision. For example, time spent in the industry determines an employee's competence and credibility. Or staying too long without promotion may mean that an employee has been blocked from moving up in the company. At the same time, even if someone has enough ability, too frequent job-hopping will have a great impact on his integrity—no company wants to take the risk of losing a key employee at any time. The decision whether to change jobs or leave is largely determined by these factors.

For employers, the length of time an employee has been with the company determines how familiar he is with the business and how closely he cooperate with others. However, the number of company's top management is limited. For employees who stay in the company for too long, it is difficult for the employer to further promote their positions, which will cause brain drain. It can be said that the company's response to the time spent in the company and the reward system is the key to maintaining the stability of the company.

Surprisingly, time related factors' definitiveness even outweighs than salary, this also indicates how important these factors are for employees and employers. This again indicates how important these factors are.

Besides that, performance rate and salary hike also hold strong definitiveness in this dataset. These two factors, one determines the degree of conscientiousness of a person's work, the other determines the promotion space of the employee. This shows

Table 7. Rotated Component Matrix

	1	2	3	4	5	6	7	8
YAC	0.915							
YCR	0.865							
YCM	0.863							
YLP	0.730							
AGE		0.800						
TWY	0.558	0.724						
NCW		0.670						
MI	0.472	0.630						
PR			0.941					
PSH			0.941					
JI				0.871				
JS					0.745			
GEN					0.639			
RS						0.874		
DFH							0.863	
SOL							0.516	
TLY								0.865

that employees are very concerned about whether they have enough room for growth and return in a company. This is also undoubtedly what companies should pay attention to. As mentioned above, the stability of a company largely depends on its reward and punishment system for promotion.

3 Conclusion

In general, whether from the company management level or from the employee's consideration of career planning. The time is always the first factor need to be considered. For employees, after joining the company four to five years, they will get in the period with the most opportunities. Whether it is job hopping or promotion, are concentrated in this period. For the company, in order to ensure the stable operation of the company and avoid talents loss, the long-term reasonable promotion and salary mechanism are often the most two important factors. At the same time, salary is often the decisive factor whether employees leave and work motivation as we all think.

References

1. Bruck, Carly S., Tammy D. Allen, and Paul E. Spector. "The relation between work–family conflict and job satisfaction: A finer-grained analysis." *Journal of vocational behavior* 60.3 (2002): 336-353.
2. Aguinis, Herman, Ryan K. Gottfredson, and Harry Joo. "Using performance management to win the talent war." *Business Horizons* 55.6 (2012): 609-616.
3. Bothma, Chris FC, and Gert Roodt. "The validation of the turnover intention scale." *SA journal of human resource management* 11.1 (2013): 1–12.
4. Rummel, Rudolf J. *Applied factor analysis*. Northwestern University Press, 1988.
5. Miettinen, Olli, and Markku Nurminen. "Comparative analysis of two rates." *Statistics in medicine* 4.2 (1985): 213-226.
6. St, Lars, and Svante Wold. "Analysis of variance (ANOVA)." *Chemometrics and intelligent laboratory systems* 6.4 (1989): 259-27
7. Streiner, David L. "Factors affecting reliability of interpretations of scree plots." *Psychological Reports* 83.2 (1998): 687-694.
8. Dziuban, Charles D., and Edwin C. Shirkey. "When is a correlation matrix appropriate for factor analysis? Some decision rules." *Psychological bulletin* 81.6 (1974): 358.
9. Jackson, Donald A. "Stopping rules in principal components analysis: a comparison of heuristical and statistical approaches." *Ecology* 74.8 (1993): 2204-2214.
10. Tranmer, Mark, and Mark Elliot. "Binary logistic regression." *Cathie Marsh for census and survey research*, paper 20 (2008).

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