Predicting Employee Turnover from Network Analysis

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Predicting Employee Turnover from Network Analysis

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Abstract. The network resources in webs of informal relationships between employees have an important influence on the working lives of people. This study examines the role of social networks in the employee intentions to quit from a quantitative approach. It investigates action network and friendship network of employees from two high-tech companies. The results indicate that employees who are less central are less committed employees who will be more likely to “fall off” the organization. From the network analysis, the likelihood of turnover could be predicted.

1. Introduction

Online social networks within the organization will increase the size of employee social groups as they reduce lots of the friction and cost involved in contacting with others. Every tie in an individual’s network represents a channel through which knowledge may flow to and from that individual [1]. The effective organizations make smart use of employee networks to improve efficiency and reduce costs.

An individual’s position in a social network leads to disadvantages, such as exit [2]. One’s position in the communication network predicts employee withdrawal and intentions to leave [3]. Mossholder et al. [4] examines in-degree centrality in relation to turnover that network centrality predicts turnover in five years’ time. Although turnover intention does not fully mirror actual turnover, it is highly correlated with turnover [5]. Strong social networks within the organization reduce turnover intention, because employees who have a high level of support from their coworkers and feel a sense of obligation toward their colleagues are less likely to quit. However, strong social networks external to the organization may have the opposite effects. Some scholars find that employee turnover is negatively associated with strong ties with internal members [6] and positively related to weak ties with external people [7]. Connections to an external network could increase turnover intention since external network could provide greater information about job opportunities to facilitate a career move.

It is worthy to investigate the relationship of network resources and employee intentions to quit. This study proposes relationships among employees predicting who are likely to leave their job. If employees don’t want to lose valued relationships with other members, they are more psychologically attached to the organization and are less likely to exit. Structural equivalence model examines turnover behavior in relation to an employee’s position in a communication network. Turnover could induce more turnover [8, 9], as a snowball effect, which could occur leaving an organization. Similarly, the erosion model introduced by Feeley and Barnett hypothesizes that employee turnover is predicted by one’s position in the communication network, and greater centrality is related to lower turnover [10].

2. The relationship between the influence of nodes in networks and turnover
2.1 Data collection
This study examines the role of social networks in the employee intentions to quit. Two data sets are included in the current research: dataset1 involves 104 employees from a market-listed Chinese company, and dataset2 regards 20 employees from one of the departments of a large multinational corporation in Chengdu. Each dataset contains action and friendship network, forming double coupled networks. Action network is directed and weighted, and the weight is the strength of interaction. Friendship network is directed and unweighted.

The basic statistics show that there are seven isolated nodes in the action network of dataset1, illustrating that the seven people exist in friendship network without involving in action network. The network density and average degree of the action network are less than that of the friendship network, indicating that the average connectivity of the friendship network is even closer. The clustering coefficients of the four networks are close to or exceed 0.8, illustrating strong clustering and showing the small-world effect. The average shortest path lengths among members of the four networks is less than two, illustrating one is connected to another through a maximum of two people. The four networks are all disassortative. The friendship network of dataset1 and the action network of dataset2 show significant disassortative mixing, i.e., high degree nodes tend to attach to low degree nodes. Heterogeneity index provides a measure of the average degree inequality in a network. The networks are heterogeneous with heterogeneity indices larger than 0.5, and other networks are homogeneous if the heterogeneity indices are all less than 0.5. There are no obvious community structures to be found in the four networks with modularity Q less than 0.1.

In conclusion, the effects obtained for network indicators based on action versus friendship relations suggest that the four networks are all disassortative and heterogeneous ‘small-world’ networks without clear community structures, and the coupled network structure of each dataset is different.

2.2 The relationship between ranking of influential nodes in networks and turnover
In order to examine the relationship between an employee’s position in a network and whether or not the individual leaves the organization, the ranking of influential nodes in networks is computed first. The following four indicators are selected: in-degree (Ki), out-degree (Ko), degree (K) and k-shell (Ks).

Freeman identified primary measures of centrality in a communication network: in and out degree, closeness, and betweenness [11]. Network centrality is measured by the degree measure: the number of out-degree and in-degree links one has. In-degree (Ki) is the number of incoming edges, which means other people take the initiative to contact me or follow me. In-degree is measured by the number of links others report having with a focal person. Out-degree (Ko) is the number of outgoing edges, indicating the connection from the person to other people. Out-degree is measured by counting the number of links one reports having with others. A person with a high out-degree is more connected and speaks to more individuals in the group. Degree (K) is measured by the total number of positions in direct contact with an individual.

K-cores are subsets of a network, which can be used to characterize network structures. The k-shell (also called k-core) decomposition of the network is used to identify the core and the periphery of the network [12]. The k-shell decomposition provides a method for identifying most influential spreaders [13]. The method assigns an integer index, Ks, to each node which represents the location of the node in the network. The first step is to remove from the network all nodes with degree k = 1, and the value Ks = 1 is assigned to them. The procedure is repeated iteratively to remove the next k shell, Ks = 2, and the routine is applied until all nodes of the network are removed. According to the k-shell decomposition method, nodes with high values of Ks are located to the center of the network, called core node. On the contrary, small values of Ks define the periphery of the network.

Pearson correlations are computed for the relationship between the indicators of influential nodes in networks and employee promotion/turnover. The Pearson correlation coefficient r could be obtained
directly by dividing the sample covariance and standard deviations of two variables [14]. Pearson first developed the mathematical formula in 1895:

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2 \sum_{i=1}^{n}(Y_i - \bar{Y})^2}}$$

Pearson correlations are used to measure relations between the network indicators and employee turnover, and the results are reported in Figure 1.

Figure 1. Correlation between the influence of nodes in networks and employee turnover.

The graph is plotted by the indicators of influential nodes on the horizontal axis and correlation on the vertical. The action network is depicted in blue, and the friendship network is depicted in pink. Fig. a represents dataset 1, Fig. b represents dataset 2.

Results indicate a negative relationship between network indicators and employee turnover. From the two data sets, the relationship between network indicators and turnover in action network is stronger than that of friendship network, indicating a stronger relationship between the influence of nodes and employee turnover in action network. Besides, k-shell (Ks) is more strongly related to turnover than degree (K) will be. These numbers also suggest a weak relationship between out-degree (Ko) and employee turnover. The results indicate that people who reside on the boundaries of the network are more likely to leave the organization.

3. Logistic regression analyses

Logistic regression analysis is performed for each network indicator on employee turnover. The classification accuracy is shown in Table 1, where results are described for all two datasets. Two networks are considered: action network and friendship network. The independent factors are action network in-degree/out-degree/degree/k-shell and friendship network in-degree/out-degree/degree/k-shell. Employee turnover is measured as a discrete variable with leavers coded 1 and stayers coded 0. First, action network is used only; and second, friendship network is used; finally the two networks are combined.

| Predictors            | Turnover Precision |
|-----------------------|--------------------|
|                       | Dataset1 | Dataset2 |
| Action In-Degree      | 76.9%    | 90%      |
| Action Out-Degree     | 84.6%    | 80%      |
| Action Degree         | 85.6%    | 85%      |
| Action K-shell        | 85.6%    | 90%      |
| Friendship In-Degree  | 83.7%    | 85%      |
| Friendship Out-Degree | 76%      | 85%      |
| Friendship Degree     | 81.7%    | 85%      |
| Friendship K-shell    | 81.7%    | 90%      |
In dataset1, there are 104 people included in the analysis. 25 people leave the organization. One employee gets promoted first and then leaves the company. The correct classification rate is high when action network and friendship network are combined, based on accurate prediction of 85.6% of leavers. In dataset2, there are 20 people involved, 4 employees exit. K-shell is successful in the prediction of 90% of all leavers correctly.

To sum it up, K-shell could predict employee turnover precisely. Peripheral people are members with fewest ties, often reside on the boundaries of the network. The peripheral position inhibits employees from maintaining healthy relationships, people at the periphery receive less information and may feel less committed to the organization, and the lack of commitment may cause the employee to leave. However, the most efficient spreaders located in the inner core of the network should be paid attention to by company top management team to avoid collective turnover. People leaving the organization will lose the potential to use the social capital which they have already built, moving to another organization can be costly as it will spend time and effort to re-build network of relationships. The supportive relationships around the employee contribute significantly in the decision to stay or leave the organization.

4. Conclusions
The study offers alternate explanations for why people exit through a data-driven approach, providing practical insights for managers trying to keep them to stay. Managers seeking to enhance employee career prospects and reduce turnover should pay attention to the current study. Employee network could forecast that people at the periphery are most likely to exit.

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