

Organizational Churn: A Roll of the Dice?

Jiaming Song

Tsinghua University

jiaming.tsong@gmail.com

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Background & Key Information

- ▶ When people are replaced within a company, the resulting turbulence is termed organizational "**churn**".
- ▶ Each team is required by the HR manager to develop a **network model**
- ▶ A employee is **more likely to churn** if he or she was connected to other former employees who have churned.
- ▶ ICM has several **levels of position**; each has a specific recruiting time, recruiting cost, salary, etc.
- ▶ Employees in different positions might have different churn rates; in specific, **mid-level positions** are more likely to suffer from churn.
- ▶ Employees in ICM can gain **promotions**, which requires several years of experience.

Hierarchical Structure of ICM

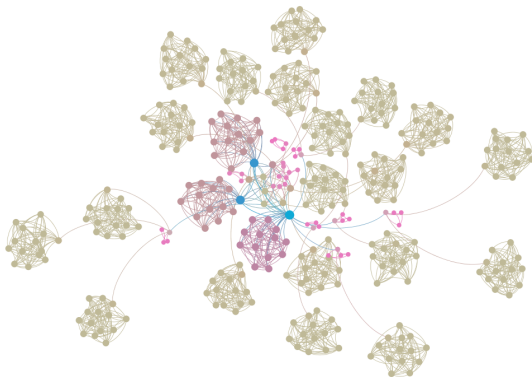


Figure: Information Network for ICM

Task Requirements

Modeling

1. Churn
2. Recruitment
3. Promotion

Evaluations

1. Costs
2. Productivity
3. HR Health

Extensions

1. Team science
2. Multilayer network

Difficulties in Modeling the Churn Process

The churn process in ICM is hard to model because:

1. Individually, the churn of the employee is affected by employees around them.
2. For ICM as a whole, the churn rate should be maintained in a small interval. (eg. around 18%)
3. Employees on different positions might have different churn rates.

Too many assumptions on the employees introduces latent factors, which require some serious parameter tuning to obtain a good model.

A Negative Example

One example of a model that introduces too much assumptions for the employees:

1. Each person has a tolerance threshold, which measures the amount of (dis)satisfaction needed for he/she to leave the company.
2. Each month, the employee increases the dissatisfaction value based on churn of other employees, his/her position, and working experience.
3. If the dissatisfaction value exceeds the threshold, the employee will leave the company next month.

Result: the employees will leave at **an exponential rate!**

Employee Churn - A Probabilistic Perspective

Conclusion: Fewer assumptions are better for simulations!

The Beta-Bernoulli Distribution

Suppose a random variable $u \in \{0, 1\}$ is drawn from a Bernoulli distribution, where p is unknown:

$$u \sim \text{Bernoulli}(u; p) = p^u(1 - p)^{1-u} \quad (1)$$

Assume an observer wants to estimate parameter p by drawing multiple u 's. The individual has a prior estimation on p , which is described as a Beta distribution:

$$f(p) \sim \text{Beta}(p; \alpha, \beta) = \frac{p^{\alpha-1}(1 - p)^{\beta-1}}{B(\alpha, \beta)} \quad (2)$$

Employee Churn - A Probabilistic Prespective

Estimating α and β

When seeing an outcome of $u = 1$, the observer updates the estimation using Bayes' law:

$$f(p) \sim (p^{\alpha-1}(1-p)^{\beta-1}) \cdot p \quad (3)$$

which can be viewed as increasing α by 1. When the observations reaches infinity, $\alpha/\beta = p$, whereas the Beta distribution reduces to $\delta(u - p)$. Also, the increase of observations reduces the variance of the Beta distribution. Integrating out p , the observer can estimate that the mean of u equals $\alpha/(\alpha + \beta)$.

An Analogy

Reality of an employee	Model
{Leave, Stay}	$u \in \{0, 1\}$
The true inclination to stay	p
The estimated inclination to stay	$\alpha/(\alpha + \beta)$
Seeing others leave	$\beta \uparrow$
Seeing other stay	$\alpha \uparrow$
Experience in company	$\alpha + \beta$

Table: Describing the reality using Beta-Bernoulli distribution

Three Issues

Determining the Prior

- ▶ Given a churn rate p , we can easily model the effect of a churn rate of p per year by setting $\beta/(\alpha + \beta) = p/12$.
- ▶ It is safe to assume that people on high level positions have a larger $(\alpha + \beta)$ compared to others, and their decisions are less volatile.

Updating $\alpha_i^{(t)}$ and $\beta_i^{(t)}$ 确定参数变化

- ▶ We normalize the update values, so that every month, an individual's $(\alpha + \beta)$ increases by 1.

Information Reduction

- ▶ We reduce the update by d^2 if the information takes at least d steps to transmit.

Algorithm

To summarize, we introduce an algorithm for this process. For every individual i :

- ▶ Sample the churn result for month t using hyperparameters $\alpha_{i,t}$ and $\beta_{i,t}$, and determine whether to stay or to leave;
- ▶ If i decides to stay, initialize two variables $\hat{\alpha}$ and $\hat{\beta}$ for update;
- ▶ For every individual j in $\Gamma^{(t)} \setminus \Theta^{(t)}$ (individuals who stays), update $\hat{\alpha} = \hat{\alpha} + \frac{1}{(d_{ij}^{(t)})^2}$;
- ▶ For every individual j in $\Omega^{(t)}$, update $\hat{\beta} = \hat{\beta} + \frac{1}{(d_{ij}^{(t)})^2}$;
- ▶ Update $\alpha_i^{(t+1)} = \alpha_i^{(t)} + \frac{\hat{\alpha}}{\hat{\alpha} + \hat{\beta}}$, and $\beta_i^{(t+1)} = \beta_i^{(t)} + \frac{\hat{\beta}}{\hat{\alpha} + \hat{\beta}}$

Promotion Models

Experience Oriented For a vacancy on level l , select the employee on level $l + 1$ with longest working experiences; the employee should also satisfy the promotion requirements.

Dissatisfaction Oriented For a vacancy on level l , select the employee with the largest β/α (or the highest churn probability) among all the employees on level $l + 1$ who satisfy the promotion requirements.

Centrality Oriented For a vacancy on level l , select the employee with the largest closeness centrality (tends to be greater when the employee is in the middle of the network) from the qualified employees on level $l + 1$.

If nobody is available, start recruiting.

Recruitment Models

Recruitment is implemented using a greedy algorithm:

- ▶ The HR manager has a maximum possible effort to recruit.
- ▶ When the number of vacant positions is higher than the maximum effort, and only try to recruit the positions with the highest levels.
- ▶ He can only renew his recruitment post over a length of period, e.g. quarterly or semi-annually.

Capabilities of the Model

- ▶ The risk of churn can be identified in early stage by observing each staff member's β/α . The higher β/α is, the more likely the staff member chooses to leave.
- ▶ The resignation of a staff member will increase the β parameter of other employees, thus increasing their chance of resigning.
- ▶ We cover the fact that churn rates for middle managers are higher than other levels of positions by allowing different priors α and β for different levels.
- ▶ The HR manager can choose recruitment effort, recruitment time period, and promotion threshold to control the recruitment flow.

Task 1

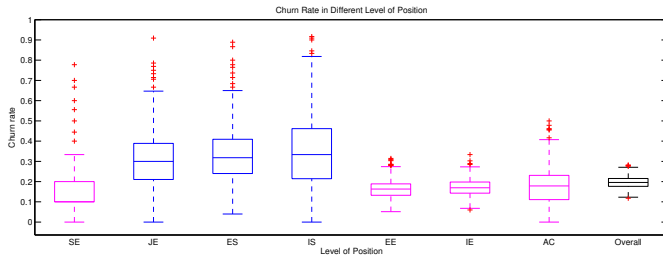


Figure: Churn Rate In Different Level of Position

Task 1

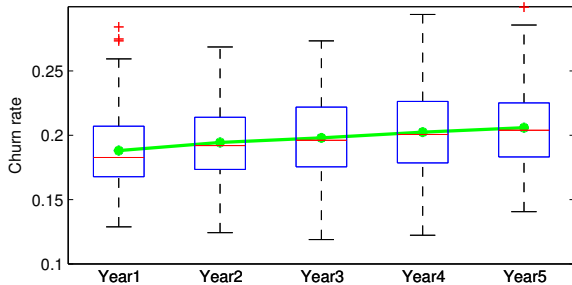


Figure: Churn Rate Change over 5 Years

Task 2

We can assume that an employee's productivity is determined by **position level**, **training experience**, and **dissatisfaction**, and that the organizational productivity is a weighted sum of individual productivity.

Direct Effect

The productivity of resigned individuals.

Indirect Effect

The loss of productivity caused by the increase of dissatisfaction of the remaining staff in the company after the resignation.

Task 2

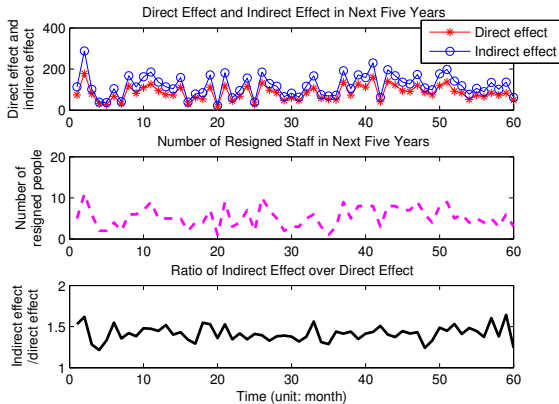


Figure: Direct Effect vs Indirect Effect

Task 3

Budget consists of three components: staff salaries, recruitment cost and training cost.

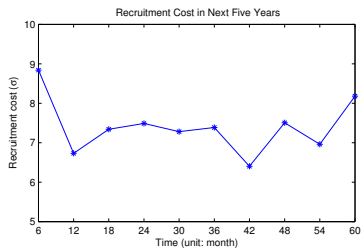


Figure: Recruitment Cost

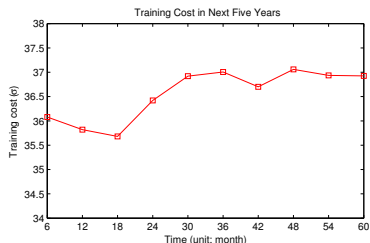


Figure: Training Cost

Task 4

β -to- α ratio:

- ▶ Churn rate of 25% per year, $\beta/\alpha = 0.25/12 = 0.02083$;
- ▶ Churn rate of 35% per year, $\beta/\alpha = 0.35/12 = 0.02916$.

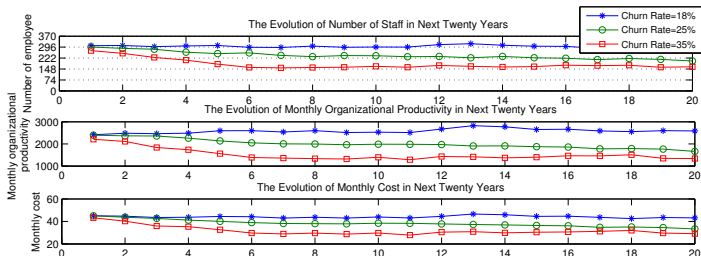


Figure: Evolution over the next 20 years

Task 4

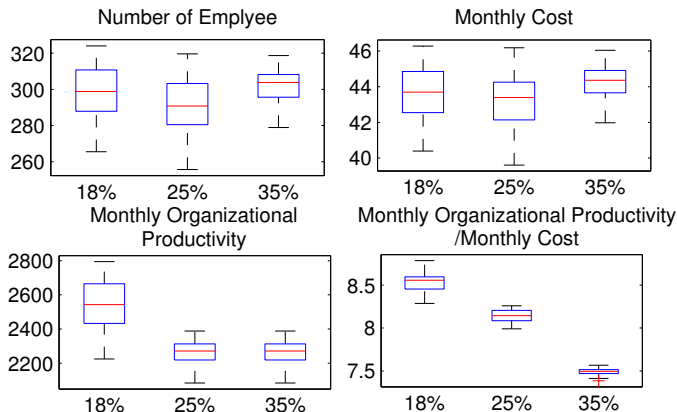


Figure: Comparison under different churn rate

Task 5

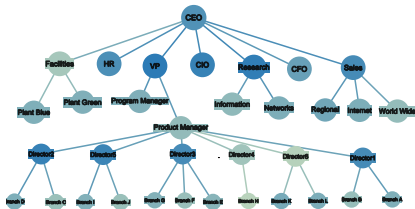


Figure: 0 months

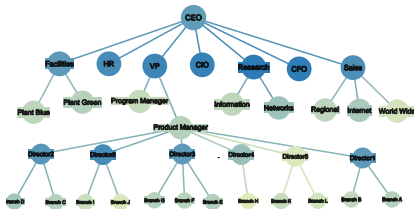


Figure: 12 months

Task 5

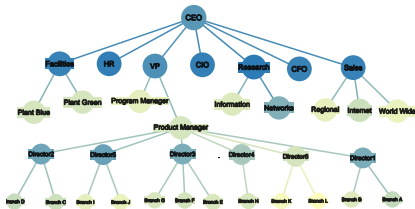


Figure: 18 months

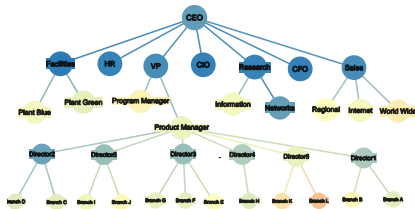


Figure: 24 months

Incorporating Team Science 团队科学

Shared cognition 共同认知 Shared cognition can form within different kinds of teams. In our context, a reasonable choice is an office. Staff working within an office share the same goal and shared cognition can positively contribute to its performance.

Team Training 团队训练 Currently, HR manager does not offer any training to the "team" or "office" as a whole. Like offering individual's training, we can take into account the team training. Being trained as a team can improve team members' understanding of each other's roles, promote teamwork and enhance team performance.

Incorporating Multilayer Networks

Now let us assume that we have incorporated teammate, friendship and trust relationship layers to our information network.

- ▶ Churn information can now also transmit along other layers of networks;
- ▶ We reduce our time slice from one month to a week, which allows more frequent information transmission between friends and teammates;
- ▶ We increase the impact of turnover decisions made by trusted individuals;
- ▶ We take friendship into account when calculating shared cognition, where friends in the same office tend to have increased shared cognition, and hence productivity.

Strengths

- ▶ **Simplicity:** We make minimum assumptions on individual characteristics: only α and β are required for inference.
- ▶ **Parameters:** The parameters reduce the need of tuning to a minimum.
- ▶ **Coverage:** Our model and measures are capable of simulating various scenarios.
- ▶ **Flexibility:** Our model can be easily incorporated with other assumptions.
- ▶ **Appealing simulation results:** Simulation results of our model are very appealing.
- ▶ **Heuristics for HR:** HR can gain considerable heuristics from our paper.

Weaknesses

- ▶ **Simulation volatility** : Although our model has nice statistical properties, results generated by different simulations suffer high volatility. One possible remedy is to increase the sampling time, which reduces outcome variance at the cost of computational resources.
- ▶ **Unrealistic assumptions**: Some of our measures are based on unrealistic foundations, e.g. productivity increases linearly with training costs, employees have no inclination towards different positions, etc.
- ▶ **Incomplete assumptions**: There are also some other perspectives where we fail to consider, such as the positive effects of team cognition on productivity.

More Information

For the paper, please visit
<https://github.com/jiamings/icm2015>.

My contact information:

- ▶ Name: Jiaming Song 宋佳铭
- ▶ Email: jiaming.tsong@gmail.com
- ▶ Mobile: 18001585905
- ▶ WeChat: dipndet