FULL PAPER

Study and building of school management echelon model based on markov matrix

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ABSTRACT

Russian mathematician Markov firstly introduces Markov chains, which is one of widely applied mathematics model in the random process. After being improved by experts it has now been widely applied in natural science, public career and engineering technology. The application of Markov matrix can enable school management echelon model to help school manage stuff more efficiently. This paper makes a specific study on the design and application of school management echelon model based on Markov matrix.

KEYWORDS

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INTRODUCTION

Problems existing in school management
The flat management model for colleges and universities
　　Nowadays, colleges and universities lack comprehensive and systemic management mechanism, the planning framework and team construction. In other words, there lacks a close connection between school strategy relationship and management plan, and the arrangement of management duties and organizations doesn't integrate with team construction.

There lacks a connection between department duty and strategic target
　　When setting specific target every functional department all stands on its own interest, without holding management target together with strategy target. Because strategy target has lost its role in guiding department's work there lacks a connection between department's functional arrangement and strategy target.

There lacks comprehensive system construction and continuing policy executing
　　All universities and colleges are perplexed by their construction of management system, which has a direct effect on school management's effectiveness and order. The utilitarian and blind consideration existing in madding policy lead to changing or variation of execution, so it's necessary to treat mechanism's construction as a systematic project.

There lacks a comprehensive and systematic management team construction
　　When school conduct human resource construction, the construction of both management team and the science and research team has been emphasized as an important guiding ideology. It is a common phenomenon that universities' functional department and decision-making level provide policy priority for teaching research, so is the construction of teaching and studying conduct, as a result the teaching stuff management has gained too much manpower and energies that there lacks an efficient input to support management team's construction, leading to the lack of completeness and systematic in selecting, training and cultivating work in the process of constructing management team.

The lack of the coordinating and communicating mechanism and a systematic engineering effect
　　One of reasons why university's low management efficiency is the loss connection between strategy target and duty, which mainly due to the lack of construction of coordination mechanism. The launching of a policy is related with many different departments. Because of the lack of efficient coordination the policy making with a positive will cannot really be practiced.

THE ANALYSIS OF PROBLEM'S CAUSE

Micro analysis
　　(1)Department of personnel is responsible for the stuffing and organization management, but the decision of setting organization and the number of department heads is made by school leadership and organization department. So department of personnel just only take the response of reviewing agency approval formalities and lacks the comprehensive study of organization and stuffing level.
　　(2)Department is responsible for deciding department's duty, but the detail is decided by department itself. There is no clear relationship between department positioning and organization's strategy target and no connection between different departments' duty.
　　(3)There exist some disorders in management such as duplication of functions, the fuzzy of responsibility and the complex relations between positions and the integration of position and duty. There also exists bull management in the process of dealing with some businesses. Department cannot really understand the meaning of organization's strategy and just focus on routine work, unable to make strategic target realize its function.
　　(4)In the management, some functions lack periodic upgrade mechanism, including structure design, duty design and job subsidies.

Macro analysis
　　(1)There lacks the emphasis on management team construction and a systematic study.
　　(2)In the long term because of system's problem university's management has a low position in human resource market and lacks attraction for excellent personnel. And the drain of personnel in management team is very serious. Universities and colleges, as public institutions, have accustomed to do things based on leader's order under the real understanding of the policy, so they cannot be flexible to conduct such orders. Although great large number of human, finance and material resources are provided for universities and colleges, they have been always in a negative position under the effect of inertial thinking.
　　(3)Because of the detective of management team construction, such as the lack of channel promotion, comprehensive salary design, managers do not satisfy current situation and cannot see their perspective, leading that they hold a negative attitude toward finishing organization strategy target, which makes a negative effect on whole management

level. Besides, it also damage the input of finance and research for constructing management team, further influencing the playing of managers' role.

THE FUNCTION OF MANAGEMENT TEAM ECHELON MODEL FOR COLLEGES AND UNIVERSITIES

The basic function
Demand forecasting
        According to the current demand of managing positions and the turnover and demission rate of ever position managers can make forecasting and well conduct the selecting, supplementing and replacing work. Based on school's future development, the management team can be adeptly expanded and certain model should be built for it, realizing the integration of management team scale and future developing strategy.

Supply forecasting
        Through accounting the number of candidates for certain position, every position's demand-supply situation can be shown clearly, making the forecasting of position's demand and supply easier. And also through learning about the outside supply-demand condition, the management team construction can be aptly adjusted, improving the whole construction's level.

The churn prediction
        The investigation of demission rate can strengthen the control of internal supply. Through analyzing demission rate in the model we can further study its reason, making sure the typical problems existing in the management construction and control them in time.

The basis of policy change
        The redundant positions provide conditions for us to adjust certain positions. For the shortage of supply the outside supply can cover the shortage. Through changing the model's using time the different positions can be sufficient and the supply forecasting will be done well. According to the forecasting of supply and demand, the supply-demand relations can be achieved balance.

Extended function
        If $p_{ij}(t)$ is the transition probability in Homogeneous Markov process, there would be limit.

$$\lim_{\Delta t \to 0} \frac{1 - p_{ii}(\Delta t)}{\Delta t} = v_i = q_{ii} < \infty; \tag{1}$$

$$\lim_{\Delta t \to 0} \frac{p_{ij}(\Delta t)}{\Delta t} = q_{ij} < \infty, i \neq j \tag{2}$$

        We call q_{ij} the transition rate when Homogeneous Markov process transforms from i to j.

        If in the continuous time Homogeneous Markov chain has a limited space $I = \{0,1,\cdots n\}$, its transition rate can constitute the following matrix.

$$Q = \begin{pmatrix} -q_{00} & q_{01} & \cdots & q_{0n} \\ q_{10} & -q_{11} & \cdots & q_{1n} \\ \vdots & \vdots & \vdots & \vdots \\ q_{n0} & q_{n1} & \cdots & -q_{nn} \end{pmatrix} \tag{3}$$

        For homogeneous Markov chain in continuous time its transition rate is not easy to get and it would be a time function, which can be got through its transition rate Q matrix.
   (1) The macro control of human resource management can be strengthened, enable the policy forecasting of high level managers to be improved.
   (2) The management team can be strengthened and the position testing would be more targeted, providing solutions for leaders' selection and cultivation.
   (3) The accounting of managers' manpower cost can be strengthened. The incentive mechanism for employees such as salary design, position promoting would gain more solutions.

(4) Managers can gain career improving channel, improving managers' consciousness and initiative to make their career planning, integrating organization's strategy target and personal target. By this way employees would cherish their posts and devote wholeheartedly to career.

(5) The test for university's managers would be improved. The training and teaching for a specific group of people would make the choosing of candidates more accurate.

(6) It would provide suggest in post recruitment, post hiring and regular stuff rating.

(7) Based on Markov matrix's researches and data basis, managers can explore and develop human resources technology such as time series method, computer simulation technology and linear programming.

THE BUILDING OF MANAGEMENT STUFF ECHELON MODEL FOR COLLEGES AND UNIVERSITIES

The analysis of Markov matrix theory

The quantitative analysis method for human resources supply is Markov matrix, which refers to with the time passing stuff in an organization can drain outside. Through study the existing regulations and policies, the transition rate and liquidity ratio would be able to be forecasted. So it's possible for people to forecast human resource position's supply-demand situation. According to the supplying situation people can conduct the promoting, testing, training and selecting work with a certain target, strengthening the echelon construction.

Assumed condition

(1) The total number and scale of posts in the management team is fixed.

(2) The number of post is equal to or above the actual number of people.

(3) In common situation there would be interference factors such as lowest place elimination mechanism. Assuming that all posts are positive and promoted, but there would be the situation such as position transforming, personnel adjustment, replacement and retirement.

Precondition

(1) The application of such a matrix enables the management model to provide promoting channel for stuff. The stuff can be promoted through selecting test.

(2) the internal human resources scale is relatively stable and the post design mechanism is complete.

(3) There is relatively stable rule for human resource's selection and promotion. The internal system is complete and its structure is stable.

The design of building management stuff echelon model for colleges and universities

Based on the relative policy the basis of management is the school's scale, which is also the foundation of making stuff's goal and organization's goal achieved. The researching basis is the school's scale, based on which the management team construction can be finished completely.

Using distribution function to describe Markov process:

If the random process is $X(t), t \in T$, the t_n is

$$PX(t_n) \leq x_n \,|\, X(t_1) = x_1, X(t_2) = x_2, ..., X(t_{n-1}) = x_{n-1}$$

(note : $X(t_n)$ in the condition of $X(t_i) = x_i$, its conditional distribution function)

$$= PX(t_n) \leq x_n \,|\, X(t_{n-1}) = x_{n-1}, x_n \in R$$

(Note: $X(t_n)$ in the condition of $)X(t_{n-1}) = x_{n-1}$, the conditional distribution function is shown below)

Or:

$$Ft_n \,|\, t_1 ... t_{n-1} (x_n, t_n \,|\, x_1, x_2, ..., x_{n-1}; t_1, t_2, ..., t_{n-1})$$

$$Ft_n \,|\, t_{n-1} (x_n, t_n \,|\, x_{n-1}, t_{n-1})$$

In such a condition, $X(t), t \in T$ has Markov characteristics, which is also called Markov process.

The number of managing stuff in colleges and universities n, r and $0 \leq t_1 \leq t_2 < ... < t_r < m; t_i, m, n + m \in T_i$

$$PX_{m+n} = a_j \,|\, X_{t1} = a_{i1}, X_{t2} = a_{i2}, ..., X_{tr} = a_{ir}, X_m = a_i$$

$$PX_{m+n} = a_j \mid X_m = a_i, a_i \in I$$

The condition of building management stuff echelon model is that when $Pi_j(m, m+n) = PX_{m+n} = a_j \mid X_m = a_i$ is under the situation that in Markov chain m is under a_i. When $m+n$ transforms to a_i the transition rage is got.

So the transition probability has arch characteristics.

$$\sum_{j=1}^{\infty} P_{ij}(m, m+n) = 1, i = 1, 2, \ldots$$
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Suppose the ratio of male and female managers is 1/3, and the ratio that male managers are more than female managers is 1/2, so the one-step transition probability and its matrix respectively is:

$$PX_n = j \mid X_{n-1} = i = \begin{cases} 1/3, i = 1, j = 0 \\ 2/3, i = 1, j = 1 \\ 1/2, i = 0, j = 0 \\ 1/2, i = 0, j = 1 \end{cases}$$

$$P = \begin{bmatrix} 1/2, 1/2 \\ 1/3, 2/3 \end{bmatrix}$$

$$P^2 = \begin{bmatrix} 5/12, 7/12 \\ 7/18, 11/18 \end{bmatrix}$$

$$P_{00}(2) = 5/12 = 0.4167$$

$$P^4 = \begin{bmatrix} 0.4005, 0.5995 \\ 0.3997, 0.6003 \end{bmatrix}$$

The percent of male managers among female managers is P01(4) = 0.5995

CONCLUSION

The application of Markov matrix to the design and application of management stuff echelon model not only can provide a strong technology support for college's human resource management forecast but also can provide a promoting channel for managers. Through strengthening manager team and building manager echelon model, the organization would have a more proper strategy and the college's operation mechanism can successfully integrate with manager's career planning, achieving humanistic management.

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