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## **Mechanism and Strategies on the Flow of Knowledge-based Talents: A Theoretical Exploration on the Chinese Enterprises**

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**Abstract:** Talents are the source of enterprises wealth creation in the knowledge-based economy times. Currently, the Chinese enterprises are facing serious problems of knowledge-based talents' flow. It is important to build management strategies through the analysis of flow mechanism. Previously, the research in this area is studied from the static perspective; however, it can also be studied from a dynamic perspective. This article used evolutionary game theory to qualitative analysis of flowing mechanism of knowledge talents in enterprises, found that enterprises do not take regulatory and talents do not flow is the ideal state. On this basis, this article also built a system dynamics model to quantitative analyses the mechanism on the flow of knowledge talents, found that remuneration and penalties have a significant impact on expanding the scale of knowledge talents. This article recommended establishing retention strategy of knowledge talents from the following aspects: Designing a competitive remuneration system, developing personalized incentives, taking punitive measures and creating viable enterprises culture.

**Key words:** Knowledge-based talents, flow mechanism, retention strategy, chinese enterprises

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### **INTRODUCTION**

In the era of knowledge-based economy, knowledge has become the synonymous with wealth. As owners of the knowledge, apparently, the role of knowledge-based talents in the value creation has become more important. Drucker (2001) pointed out that a growing number of enterprises managers already are intellectuals, they are intellectual workers and they are no longer the boss's subordinates, but partner. This shows that the knowledge-based talents rely on technology, innovation and management, analysis, injecting added value for the product. Because they have become an indispensable support for enterprises development, their flow behavior will make a heavy blow to the enterprises, such as enterprises benefits decline, brand damage, loss of trade secrets, a team low morale and so on. Therefore, researching knowledge-based talents' personality traits, revealing their flow mechanism to establish retention strategy is necessary and reasonable for the enterprises. Zhang (2005) believes that these knowledge-based talents who with high personal qualities such as being strong and independent, innovative, high liquidity, high achievement motivation and work complexity, because of these complex properties, enterprises must pay more attention to the management of knowledge-based talents.

Hiltrop (1999) pointed out that the factors affecting the knowledge-based talents' flow including remuneration, challenges, training and promotion opportunities, socio-economic status, autonomy, career responsibilities, career security and career development opportunities. Yang and Zhou (2008) build the knowledge-based talents' flow and loss control model from the perspective of psychological contract, stressed the importance of optimizing knowledge-based talents' psychological contract. Kong and Zhang (2013) analyzed through the organizational commitment theory, found that intrinsic motivation, including work, personal growth, achievement, as well as extrinsic motivators, such as salaries, highly independent, external recognition, are the major factors causing the flow of knowledge-based talents. In addition, the quantitative researches in recent years are also noticeable, such as Suo *et al.* (2013) and Lu *et al.* (2013) studies. This article based on the perspective of enterprises management, used evolutionary game theory to qualitatively analysis the flow of knowledge-based talents, explored possible strategy options and the appropriate strategy results. On this basis, this article also built system dynamics models to quantitatively analyze the behavior of enterprises and knowledge-based talents, revealed the evolution mechanism of both behavior and income. At the end of it,

this article made several suggestions for construction of knowledge-based talents retention strategy in the hope that opens up new perspectives for researching and managing the flow of knowledge-based talents.

**EVOLUTIONARY GAME ANALYSIS**

**Theoretical assumptions:** According to March and Simon (1958), conflicts between development space and the career expectations are important factors leading the flow of talents, enterprises must established retention strategy to prevent the flow of talents. However, the enterprises monitoring measures and the flow of talents must pay a certain cost, which will influence the will of enterprises supervision and talents' flow, both sides pursue their maximum benefits in the process of continuing game and their strategy choice is bounded rationality and non-optimality. Therefore, this article maked the assumption and used the evolutionary game theory to analysis:

- Game between enterprises and knowledge-based talents, participants are both bounded rationality
- Participants in the game have only incomplete information
- In the game, enterprises can select the strategic space of  $S_1 = \{\text{supervise, not supervise}\}$
- In the game, knowledge-based talents can select the strategic space of  $S_2 = \{\text{flow, not flow}\}$

**Game analysis:** Knowledge-based talents for enterprises to create income is  $R_1$ , the remuneration paid to knowledge-based talents is  $R_2$ , cost of enterprises to adopt regulatory measures is  $C_1$ , the penalties of knowledge-based talents' flow behavior be found is  $C_2$ , expected revenue of knowledge-based talents flow is  $L_1$ , losses due to flow of knowledge-based talents is  $L_2$ , the probability of knowledge-based talents' flow behavior is  $x$ , the probability of do not flow is  $1-x$  ( $0 \leq x \leq 1$ ), the probability of enterprises to supervise is  $y$ , the probability of do not supervise is  $1-y$  ( $0 \leq y \leq 1$ ),  $R_1, R_2, C_1, C_2, L_1$  and  $L_2$  are non-negative real number. The payoff matrix in the process of enterprises knowledge-based talents' flow as shown in Table 1.

From Table 1, expected revenue of enterprises supervises is:

Table 1: Payoff matrix in the process of enterprises knowledge-based talents' flow

Participants in the game		Knowledge-based talents	
		Flow (x)	Not flow (1-x)
Enterprises	Supervise (y)	$(C_2-C_1-L_2, L_1-C_2)$	$(R_1-R_2-C_1, R_2)$
	Not supervise (1-y)	$(-L_2, L_1)$	$(R_1-R_2, R_2)$

$$U_1 = x(C_2-C_1-L_2)+(1-x)(R_1-R_2-C_1)$$

Expected revenue of enterprises do not supervise is:

$$U_2 = xL_2+(1-x)(R_1-R_2)$$

Average revenue of enterprises is:

$$\bar{U}_3 = yU_1 + (1-y)U_2$$

Expected revenue of knowledge-based talents flow is:

$$U_4 = yU_1+(1-y)U_2$$

Expected revenue of knowledge-based talents do not flow is:

$$U_5 = R_2$$

Average revenue of knowledge-based talents is:

$$\bar{U}_6 = xU_4 + (1-x)U_5$$

According to the Malthusian dynamic equation, constructing dynamic equation of enterprises and knowledge-based talents as follows:

$$\begin{cases} \frac{dx}{dt} = x(U_4 - \bar{U}_6) = x(1-x)(L_1 - R_2 - yC_2) \\ \frac{dy}{dt} = y(U_1 - \bar{U}_3) = y(1-y)(xC_2 - C_1) \end{cases}$$

Jacobin matrix is obtained:

$$J = \begin{pmatrix} (2x-1)(R_2 - L_1 + yC_2) & x(x-1)C_2 \\ -y(y-1)C_2 & (2y-1)(C_1 - xC_2) \end{pmatrix}$$

**Game results:** Hypothesis:

$$\frac{dx}{dt} = 0$$

and:

$$\frac{dy}{dt} = 0$$

available 5 equilibrium points of evolutionary game in the plane  $M = \{(x,y)|0 \leq x, y \leq 1\}$  as follows:

$$E_1(0, 0), E_2(0, 1), E_3(1, 0), E_4(1, 1)$$

and  $E_5$ :

$$\left( \frac{C_1}{C_2}, \frac{L_1 - R_2}{C_2} \right)$$

Substitute equilibrium points back into Jacobin matrix, judging stability of equilibrium point by symbols of eigenvalues.

- **Situation 1:** When  $C_1 < C_2$  and  $L_1 < R_2$ , the equilibrium point is  $E_1 (0, 0)$ . At this moment, the penalties of knowledge-based talents' flow are higher than the cost of enterprises supervision. Stable strategy of the evolutionary game is enterprises does not supervise, talents do not flow
- **Situation 2:** When  $C_1 < C_2$  and  $L_1 > R_2 + C_2$ , the equilibrium point is  $E_4 (1, 1)$ . At this moment, the penalties of knowledge-based talents' flow are higher than the cost of enterprises supervision and expected revenue of knowledge-based talents flow is higher than the sum of remuneration and penalties. Stable strategy of the evolutionary game is enterprises supervise talents flow
- **Situation 3:** When  $C_1 > C_2$  and  $R_2 < L_1 < R_2 + C_2$ , the equilibrium point is  $E_5 (1, 0)$ . At this moment, the cost of enterprises supervision is higher than the penalties of knowledge-based talents' flow and expected revenue of knowledge-based talents flow is higher than the remuneration, but lower than the sum of remuneration and penalties. Stable strategy of the evolutionary game is enterprises dose not supervise, talents flow
- **Situation 4:** When the  $E_5$ :

$$\left( \frac{C_1}{C_2}, \frac{L_1 - R_2}{C_2} \right)$$

is the equilibrium point in the plane  $M = \{(x,y)|0 \leq x, y \leq 1\}$ , must meet both conditions:

$$0 < \frac{C_1}{C_2} < 1$$

and:

$$0 < \frac{L_1 - R_2}{C_2} < 1$$

which means that  $0 < C_1 < C_2$  and  $R_2 < L_1 < C_2 + R_2$ , the center point is:

$$\left( \frac{C_1}{C_2}, \frac{L_1 - R_2}{C_2} \right)$$

At this moment, system reaches dynamic equilibrium. Enterprises with the probability of:

$$\frac{L_1 - R_2}{C_2}$$

to supervise and knowledge-based talents with the probability of:

$$\frac{C_1}{C_2}$$

to flow.

Analysis situations above, enterprises whether to take regulatory measures mainly related to the supervision costs of  $C_1$  and knowledge-based talents whether to flow mainly related to remuneration of  $R_2$  and penalties of  $C_2$ . Specifically, the system state in situation 1 is ideal, that enterprises do not supervise and talents do not flow. Situation 2, 3 and 4 are the "locked" status. Due to both sides of the game having "Myopic Best Dynamic" (Dai and Mei, 2013), therefore, by increasing penalties  $C_2$  can increase the cost of knowledge-based talents' flow, by raising remuneration  $R_2$  can reduces the revenue of knowledge-based talents' flow. Bridging the gap between development space and career expectations and implement the necessary means of supervisory control constitute the retention strategy of knowledge-based talents. This conclusion coincides with March and Simon's point of view. On the basis of game analysis, the article makes further assumptions as follows:

- The longer knowledge-based talents work in enterprises, the higher the job performance and expectations, the more obvious motivation to pursue better development opportunities. In this process, enterprises take the necessary intervening measures, such as the penalties of flow behavior, improve the remuneration of talents and can bridge the gap between development space and career expectations, so as to inhibit the wills of knowledge-based talents' flow
- Flow of knowledge-based talents will have a negative effect on enterprises, regulatory measures to curb flow of knowledge-based talents must be taken, however this requires a certain degree of regulatory costs. Taking stringent punitive measures not only makes up for monitoring capital of enterprises,

conducive to improve the supervision will of enterprises, but also plays warning effects on the flow behavior, thereby reduce the flow will of knowledge-based talents

**SYSTEM DYNAMIC ANALYSIS**

**System flow chart:** On the basis of the analysis above, combined with internal and external factors which may lead to flow of knowledge-based talents, the article presented the system flow chart of knowledge-based talents' flow as shown in Fig. 1.

The model in Fig. 1 consists of 1 state variable: Scale of Talents (ST), 2 rate variables: Demand for Talents (DT) and Flow of Talents (FT), 10 auxiliary variables: Scale Expansion of Enterprises (SEE), Job Performance (JP), Productive Capacity (PC), Human Resource Cost (HRC), Remuneration (R), Flow Penalties (FP), Supervision Costs of Enterprises (SCE), Expected Revenue of Talents (ERT), Flow Wills of Talents (FWT), Supervision Will of Enterprises (SWE).

**Design equation:** In terms of state variables, scale of talents are directly influenced by flow and demand, equation is expressed as:

$$ST = \text{INTEG} (DT-FT, 100)$$

In terms of rate variables, demand for talents is determined by the scale expansion of enterprises. In reality, the demand is a non-negative number, conditional function is expressed as:

$$DT = \text{IF THEN ELSE} (SEE > 0, SEE, 0)$$

Similarly, flow of talents is determined by the flow wills of talents and the supervision will of enterprises, conditional function is expressed as:

$$FT = \text{IF THEN ELSE} (FWT > SWE, FWT-SWE, 0)$$

In terms of auxiliary variables:

- HRC = ST×0.2
- SCE = HRC×0.2
- R = HRC× 0.2
- FP = R×1.5
- SEE = JP-HRC
- JP = WA-FWT

Already know from the game analysis above, whether enterprises takes regulatory measures mainly related to supervision costs, however, flow penalties can effectively make up for supervision costs of enterprises. Therefore, when the flow penalties are higher than the supervision costs, enterprises would have a higher willingness to supervise, on the contrary, the willingness is weak, equation is expressed as:

$$SWE = \text{IF THEN ELSE} (SCE < FP, FP-SCE, 0)$$

Similarly, whether talents flow mainly related to expected revenue, when expected revenue higher than remuneration and flow penalties, talents have a higher willingness to flow, on the contrary, the willingness is weak, equation is expressed as:

$$FWT = \text{IF THEN ELSE} (ERT > R+FP, ERT-R-FP, 0)$$

The expected revenue of talents mainly related to average wage levels of industry, with industry to mature, showing a trend of rising first and then stable. In order to facilitate research, this article uses a table function to simplify processing and equation is expressed as:

$$FWT = \text{WITH LOOKUP} (\text{Time} ([ (0, 0)- (100, 100)] (0, 15) (60, 45) (100, 50)))$$

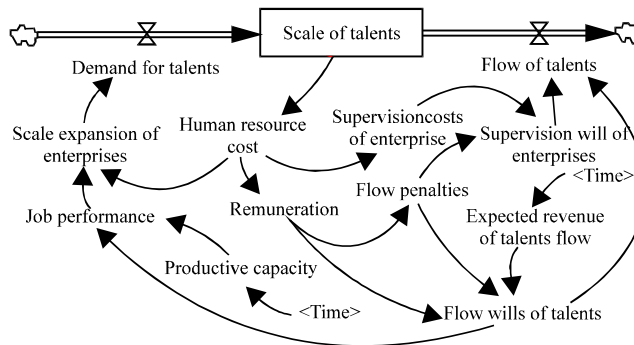


Fig. 1: System flow chart of knowledge-based talents' flow

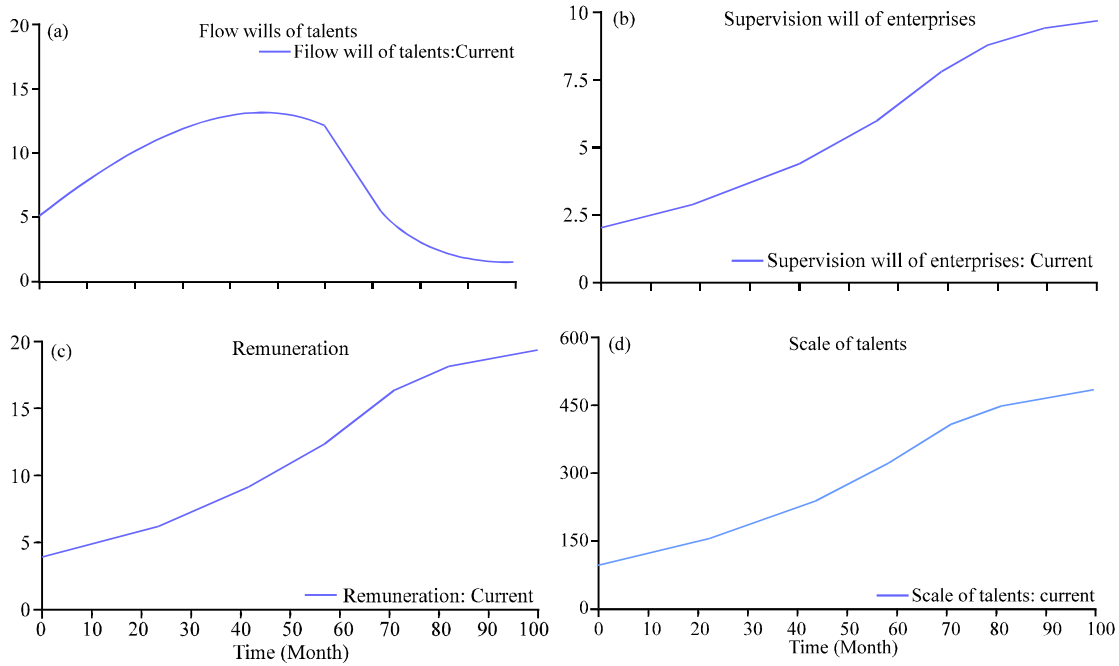


Fig. 2: Simulation results of knowledge-based talents flow

As above, at the beginning, work ability of talents continuously improve, after entering the slow lifting phase, equation is expressed as:

$$WA = \text{WITH LOOKUP}(\text{Time}([(0, 0)-(100, 200)](0, 30)(60, 90)(100, 100)))$$

**Evolution simulation:** The purpose of evolutionary simulation is to validate correctness and validity of the model; only after the confirmation these two points can use model awareness and understanding of the real issues. The following use Vensim PLE software platform for simulation. System initializer: Initial time = 0, final time = 100, time step = 1. Variable initializer: enterprises with a certain number of talent storage set the initial value of knowledge-based talents to 100. External development opportunities attractive to knowledge-based talents thus set the initial value of expected revenue to 15. Knowledge-based talents enter the enterprises with the basic skills, so set the initial value of work ability to 30. Run simulation software and get the main variables trend as shown in Fig. 2.

**Analysis of simulation results can be seen:** The flow will of knowledge-based talents is continuing to rise in the earlier time, grow into a static condition in the medium term and will keep falling down at a later stage. Combining with the remuneration of knowledge-based talents, it is

easy to find out that the trend is in accordance with the reality. At the beginning of work, their experiences are of a slight deficiency, they are hardly competence even they have better external development opportunities. As time goes, the experiences of them are constantly accumulating and the remuneration often unable to meet their expectations. At the same time, the attraction of external opportunities is emerging, knowledge-based talents would have a strong flow will at this time. But in the later stage, their capacity for work stalls and the flow at this time means the break of the long established network of relationships, so the flow will of them intend to be lower at this stage.

The supervision will of enterprises appears to rise at first and then trends to be subsiding. And it is closely related to the penalties of talents' flow and the cost of enterprises' supervision. Meanwhile, the penalties of talents' flow are associated with the remuneration, the higher the remuneration they obtain, the more relevant penalties they will get. Therefore, the evolution tendency of enterprises' supervision will is almost in line with the operation rules of the penalties and the remuneration. This tendency proves the hypothesis that severe penalties of talents' flow can compensate with the cost of enterprises' supervision, so as to improve enterprises' supervision will.

Remuneration of knowledge-based talents is related to many factors, the improvement of talents' capacity for

work is the immediate cause and the enhancement of the expected revenue lead by the attraction of the external development opportunities is the remote cause. It is not difficult to understand that the remuneration of knowledge-based talents keeps the pace with their capacity for work to a large extent, when the attraction of the development opportunities from the enterprises exterior is increasing, the enterprises should give competitive remuneration to knowledge-based talents. The evolutionary trend of the rise at first and the slowdown afterwards is in accordance with the fact.

Under the combined effects of turnover rate and the quantity demanded of talents, the number of knowledge-based talents is scale up and then enters into a relatively stable stage. Analysis on the trend, on one hand, the gradual rise in remuneration and the continual increase in the flow penalties actively suppress knowledge-based talents' flow will; as time goes on they are tend to settled down and stop flowing. On the other hand, in the process of the enterprises' operation scale from rapid expansion to gradually stabilizing, the speed of development keeps in growing yet is slowing down, the demand for talents maintain at a low level finally. Therefore, with the impact of the demand and flow, the scale of enterprises' knowledge-based talents expands at first and then trends to reach a plateau.

## **CONCLUSION AND RECOMMENDATIONS**

This article used evolutionary game theory to analyze the mechanism of knowledge-based talents' flow, found that enterprises do not supervise and talents do not flow is the ideal state and increase remuneration and penalties can approach the ideal state of evolutionary game. Based on the evolutionary game, establishing of system dynamic model to analysis enterprises supervision and talents' flow, found that remuneration and penalties gradually enhanced, scale of knowledge-based talents gradually increases. Therefore, it can be concluded that remuneration and penalties have an important influence on maintaining and strengthening the scale of knowledge-based talents. To establish retention strategy of knowledge-based talents, the article recommends that enterprises should make efforts in the following aspects:

First, design competitive remuneration system. For knowledge-based talents, remuneration is not only the basic demand of their own quality of life, but also the immediate way to experience the degree of cognition from enterprises for their work. However, the source to satisfy the requirement of knowledge-based talents is not limited with enterprises; it can come from the exterior of enterprises as other enterprises can not only provide

superior remuneration to ensure the survival and development of them, but also reveal their respects and honesty. Once the exterior temptation appears in front of knowledge-based talents, but the enterprises do not pay close attention to their psychological changes, the flow of knowledge-based talents occurs. Therefore, establishment of enterprises' remuneration system should take the joint demand of the mind and body of knowledge-based talents into account. They should know the condition of remuneration in their industry by consulting and researching of other companies to ensure the remuneration level of the enterprises keeps on the top of the industry remuneration level. Only in this way should they attract and condense the talents.

Second, establish humanized incentive mechanism. Material incentives and spiritual motivations are two important dimensions within incentive mechanism. Because the spiritual incentives are difficult to quantify, this article only reflects the role of incentives in the study on the model, but this does not mean that enterprises can ignore the impact of spiritual incentives. Establishment of personalized incentives must be combined with knowledge-based talents' personality and demand so as to issue a targeted intervention. Knowledge-based talents usually have strong autonomy, innovation and high motivation for achievements. For knowledge-based talents of strong autonomy, what they need is the opportunity to pursue and exercise them, then the incentives can be taken are the education and training opportunities or an appropriate degree of challenge for them. In terms of knowledge-based talents with motivation, they are happy to develop their talents and wisdom and eager to obtain the appropriate return. Therefore, the effective incentive is to give them material reward or honorable reputation in accordance with their achievements. And in the case of knowledge-based talents of high achievement motivation, they hope to obtain recognition and respect through efforts, for this reason, appropriate opportunities for advancement to meet their spiritual are needed in a timely manner. It is true that in reality knowledge-based talents are of the blending of several possible qualities and needs, in order to achieve the ideal incentive effect, personalized incentive programs varied from person to person in accordance with their characters are needed.

Third, adopt cautionary punitive measures. In the course of the construction of enterprises' knowledge-based talents retention strategy, personalized incentives are positive measures to curb the flow of knowledge-based talents and then cautionary punitive measures are the relative negative measures. It is worth mentioning that the punitive measures are not the severe the better even

in order to play a cautionary tale. Too much of penalties are easier to combat talents' initiative, yet too light of them may not afford the cautionary tale. Therefore punitive measures must be in line with reasonable and moderate principle and start from two-pronged approach in improving psychological and economic costs of knowledge-based talents. In terms of psychological cost, criticism and warning should be included into supervision of talent management so as to make knowledge-based talents realize that once of their flow should result in the facing of enterprises' notice of criticism which could affect the reputation of theirs within the enterprises and industry. In terms of economic costs, flow fines of knowledge-based talents should positively associated with remuneration they obtain from enterprises; namely, increase the flow fines with the improvement of their remuneration. By this means, flow fines will likely offset the benefits of knowledge-based talents' flow; thereby reduce the flow will of them.

Forth, build a viable enterprises culture. If the remuneration system and talent incentive mechanism are the hard power of the establishment of retention strategy, then the enterprises culture is the soft power join the chorus with them. Enterprises culture is not a virtual fantasy; it is the soul of enterprises' development and the institution guarantee of the internalizing into the talents' values of enterprises vision. Although enterprises culture does not have strong enforcement force, sometimes it is more inspiring than remuneration and incentive. An excellent enterprises culture is the accumulation of success, a reflection of failure, the essence of innovation, the transformation of conservative, the lively supporter that is constantly growing. A lively enterprises culture could win without a fight; the case of Apple is a strong evidence of the radiation of enterprises culture to the world. Therefore, the creation of lively enterprises culture can not only gain consensus, help enterprises to attract talents and win support of people but also help

enterprises to become the core of competence that can't be reproduced by their competitors and sail through and go ahead in business competition.

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