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Relationship between Profit-sharing Coefficient Model of Research and Development Personnel Creative Activities on Intellectual Element Investment

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Abstract: The study is aim to encourage the creative activities of research and development personnel to achieve sustainable creative activities. With the aspect of economic measures and profit-sharing theory, the result is put forward that intellectual element is considered as the productive factor in creative production. By the method of value analysis, encouraging principles and their effects of research and development personnel creative activities' theoretical sharing on intellectual element investment are analyzed. And the conclusion of this study is the maximum profit-sharing coefficient of research and development personnel engaged in creative activities is deduced as a constant, that is the maximum sum of profit-sharing coefficient of research and development personnel takes 25% of the value brought to enterprise by creative activities after imitating the mathematical model of creative activities and taking enterprise profit maximum as purpose.

Key words: Creative activities, intellectual element, profit-sharing coefficient, research and development

INTRODUCTION

The knowledge contributed in creative activities by research and development personnel plays a very important role in the productive forces of enterprise creative activities. At the age of knowledge economy, form the constitution of productive forces, two basic key elements are included especially in enterprises with many creative activities: First, material element, namely, the material part of productive forces which includes the person himself engaging in research and development activities, working instruments and material elements in working objects; intellectual element, namely, the integration of all intellectual achievements used and produced in research and development personnel creative activities, including a series of intellectual achievements, such as data, information, signal and recognition during the course of research and development personnel creative activities (Li, 2008). Of course, the division of the two elements is only in the analysis of meaning; while in reality, the two elements-material and intellectual are mixed together-cannot be separated. This kind of productive force is shown by possession, alteration and application by research and development personnel; material element is the essential quality of productive force, while intellectual element is the soul of it. The operation of knowledge depends on the basis offered by material elements, while the depth and length of material element's

operation are decided by the developing situation of intellectual elements. These two elements will have influence on each other and will also boost the development to create new fortune to the enterprises.

At present, there are not many studies on the profit-sharing of research and development personnel creative activities on investment of intellectual elements, however, studies on profit-sharing of scientific and technological personnel on investment of technology which can be taken as references are pretty much. So, the aim of the study is to encourage the creative activities of research and development personnel to achieve sustainable creative activities.

Profit-sharing allocation in accordance with contribution: Mannheim Bilha. Angel Orly, Zucker hynne Gh and Darby Michaelk state technology plays a very important role in creating the using value of products, so stimulating salary policy should be adopted to attract and maintain the most excellent scientific and technological personnel. And one of the ideal ways is to put technological element into profit-sharing. Ghingold and Johnson (1997) also argued, for most industrial enterprises, the competitive force is decided, to a large degree, by the technological level of employees (Ghingold and Johnson, 1997). Technological knowledge increases the value of business market and of course should be taken into consideration when allocating the profit of

enterprises. Mainiero and DeMichiell (1986) also states encouraging salary system like new technology should be adopted (Mainiero and DeMichiell, 1986). Most scholars argue it is a critical stimulating system to put productive elements into allocation in accordance with contribution in market-driven economic situation. Technology is regarded as an independent element in allocation contribution because it becomes much stronger and the contributive rate is gradually increasing.

Profit-sharing allocation in accordance with ownership:

It is the key principle in market economy that the productive elements participated in profit-sharing allocation is the realization form in economy of ownerships. The tax committee in US argues this profit allocation has already adopted by some special business field like high-tech field (Victor and Jeffrey, 1998). Michael C. Jensen mention in the book *Foundations of Organizational Strategy* that the ownership of scientific and technological talents' asset includes the profit-sharing right of them.

When the asset exists as the form of human asset, it takes part not only in the course of production and management, but also profit-sharing allocation at the identity of asset owners. So, it has objectivity and necessity to make the talents participated into profit-sharing allocation (Chyu and Huang, 2010).

Profit-sharing allocation in accordance with residual claim right:

In Holmstrom and Milgrom (1987) have their model published to prove that when the information are not symmetrical (Holmstrom and Milgrom, 1987), the best stimulation is to shoulder the corresponding risk in accordance with the uncertain residual claim profit Grossman and Hart (1986) defined the ownership of enterprise as residual control right in their classical works (Grossman and Hart, 1986) that residual claim should be the right of both the shareholders and employees; in the year of 2000, Schuster and Zingheim mention in the book *Pay People Right* that the enterprise should pay attention to profit-sharing allocation to several key factors, that is, teamwork, talents, sale ability and senior managers.

ORIGIN AND DEVELOPMENT OF PROFIT-SHARING AND STIMULATION EFFECTS

Origin and development of profit-sharing: Profit-sharing, also called bonus, is shorten from the phrase profit-sharing distribution, namely, according to certain ratio, the profit seeking businesses distribute a sum of residual after tax to employees engaging in production, sales, after

sale service and management as some kind of reward for their yearly hardworking (McCarthy *et al.*, 2010). The International Congress on Profit Sharing held in Paris, France in 1899 defined profit-sharing as an agreement freely entered into, by which the employee receives a share, fixed in advance, of the profits, is in harmony with equity and with the essential principles underlying all legislation (Ferguson and Reio Jr., 2010). But profit-sharing can be originated in France in the early 1840s, it made its first appearance in Britain in the mid-1860s, where it was taken up by the Yorkshire colliery firm, Henry Briggs, Son and Co. following a intense industrial dispute over underground work practices. By 1912, 133 British firms, employing a total of 106,000 workers, were conducting profit-sharing schemes and the strategy had become the centerpiece of the labor policies of several major British industrial firms. It had also become a central constituent of the systematic management approach advocated by Edward Cadbury and other proponents of industrial welfarism; a prominent British alternative to the individualized incentive pay strategies advocated by Taylorists and other exponents of scientific management. However, most pre-war experiments in profit-sharing were very short-lived, having an average life expectancy of around ten years. Moreover, while Taylorists and others repeatedly challenged the strategy's ability to enhance labor productivity, its class collaborationist overtones also drew strong criticism from sections of the British labor and socialist movements. The Fabian socialist publicist, Edward Pease, decried profit-sharing as a piffling palliative.

The practice attained the peak of its popularity in Britain and the United States during the economic boom of the mid-1920s and against the backdrop of the acute labor unrest of the years immediately following World War I. By 1929 there were over 500 such schemes operating in British industry, covering over a quarter of a million employees or about 2% of British wage earners. Enthusiasm for profit-sharing ebbed following the collapse in profitability during the Great Depression of the 1930s and since the 1940s, interest has waxed and waned in line with prevailing economic conditions, with most interest being shown during the cyclical booms of the 1950s-60s and 1980s.

With a view to shedding more light on the long-term impact of such schemes, this study examines the origin, development and principles of profit-sharing and constructs mathematical models for maximum sharing coefficients. For the entity of allocation, profit-sharing is limited to profit seeking businesses, the financial group's artificial person of non-profit enterprises or public welfare

communities can't allocate profit, because they have no concept of profit and at the same time, they are not in the pursuit of profit; for the object of allocation, it is a sum of residual after tax which differs from performance bonus, perfect attendance bonus or December bonus which are allocated before tax paying; for the people who can receive profit-sharing, it can be any employee of the company from manager to salesman; for the time of allocation, profit-sharing is allocated at the time of year-end clearing when having residual, so profit-sharing won't be allocated when having no residual.

Profit-sharing principles on intellectual element investment: The following principles should be followed when establishing creative activities profit-sharing of research and development personnel on intellectual elements investment.

Meet the standard of business value: The intellectual elements of research and development personnel should undoubtedly have business value. Only under this demand can the intellectual elements of research and development personnel trade with enterprises (Meili and Chunsheng, 2013). One the one hand, the intellectual elements with business value can be converted to currency asset. If the intellectual elements are lack of market foreground, they have no real meaning when combined with currency asset and no enterprises will be willing to convert them to asset (Tan, 2013). One the other hand, though the intellectual elements like creative achievements of research and development personnel are belonging to enterprise, only when the owners of enterprises and the stimulated research and development personnel can acquire more anticipated effects on the basis of received interests can stimulation be carried on and intellectual elements be sustainable created by the personnel.

Put emphasis on social value stimulation: As creators of intellectual elements, the creative activities of research and development personnel are inspired by working value, personal characteristics and motivations inside and outside, while the first three are the primary factors and motivations (Wang, 2013). Therefore, if the enterprises only have currency stimulation on business value on research and development personnel, while neglecting stimulation on social value created by the personnel, then the negative effects will be created. Firstly, the neglecting will weaken the inner motivation of research and development personnel creative activities and put more emphasis on business value, consequently, the research and development personnel will be induced to the creative

mind of pure money, then more immature creative activities will be brought to the enterprise or sustainable increasing the currency stimulation will be conducted by the enterprise, therefore, many scientific and technological creative ideas with value will be lost. Secondly, the achievement of research and development personnel has a huge gap between business and social values. If the business value is over stressed, while social value being neglected, the social status, reputation will be decreased a lot or even be lost.

Put emphasis on material asset: Undoubtedly, the production and operation of research and development personnel need the incubation and support of material asset. The intellectual elements with high business value are normally belonging to high risk projects at the very early period, so the material asset investors need to shoulder the responsibility of higher risks. Therefore, the research and development personnel should have correct understanding of the role played by material asset and shouldn't over stress the intellectual investment.

Stimulating effect of profit-sharing: The stimulation of profit-sharing refers to, according to enterprise annual interest degree, economic interest stimulation for research and development personnel engaged in creative activities besides salary. The annual interest doesn't refer to the whole profit, but profit brought by research and development personnel creative activities. The aim of stimulation is to keep research and development personnel creative spirit high and sustainable. The stimulation can make the research and development personnel witness the economic interest brought by their own creative activities. However, the economic profit brought by long term stimulation of stock option can only be shown after several years or even a longer period of time. So the year-end profit-sharing can provide periodical economic stimulations for research and development personnel. Profit-sharing can make research and development personnel witness the profit brought to enterprises in different periods which can also strengthen their confidence. At the same time, profit-sharing makes the personnel see the economic return of the enterprises brought by their own creative investment and activities which also strengthens their creative motivation and behavior. More importantly, stimulation is good for increasing enterprise outstanding achievements. Profit-sharing stimulation system can encourage the research and development personnel to put their mind into more creations. Under the traditional salary system, the personnel pay more attention to their work but not

thinking initiatively how to further create new products. Even when finishing the creative tasks assigned by enterprises, their purposes are to finish this task which in the long run is not good for the long term development of the enterprise. At the same time, the research and development personnel will be in the pursuit of tasks which are easy to be finished, for instance, some short term, one level and rapidly finished creative projects with low scientific and technological content and market value. Because of basic salary and little bonus for creative achievements, projects with long term value are neglected. While profit-sharing is allocated after the value achieved in the market. In order to achieve maximum profit, the research and development personnel need to pay more attention to the long term development of the enterprises. Meanwhile, profit-sharing can stimulate the personnel's spirit and dig the potential of talents at utmost as well; consequently, long lasting nucleus competitive forces can be acquired by enterprises. However, the traditional salary system will not have such power and the research and development personnel may possibly work only in accordance with salary, of course, they may not wholly display their utmost ability for the achievements of enterprises. In contrast, the profit-sharing stimulation system, especially from the aspect of research and development personnel themselves, can in turn make them contribute more for the increasing of enterprise achievements and bring more profit return and reward besides salary.

PROFIT-SHARING COEFFICIENT MODEL DESIGN OF RESEARCH AND DEVELOPMENT PERSONNEL CREATIVE ACTIVITIES ON INTELLECTUAL ELEMENTS INVESTMENT

To arouse the enthusiasm of research and development personnel creative activities, annual profit-sharing is one of the most important stimulating methods, but extravagant bonus will lessen the profit of the enterprise, while very low bonus will not effectively have stimulation on the personnel. So, how to make the maximum limit of research and development personnel profit-sharing coefficient effectively under the premise of enterprise value maximization?

The mathematical model of the course of research and development personnel creative activities established in this study is hypothesized at the basis that the research and development personnel and the enterprises engaged in creative activities have medium risk and the efforts of the personnel are unnoticeable, then the calculating methods and formulas of profit-sharing coefficient are studied.

Methodology: Participation of research and development personnel in distribution is based on the ownership of intellectual capital, implicating *jus fruendi* aut *fructus* of intellectual capital. Therefore, the methodology of this study is based on the working motivation of research and development personnel which is generated by multi-influencing factors. Under the requirement of regression model for normality and homogeneity of variance of response variable, the expected value of response variable and linear combination of explaining variable are connected in this methodology. Through the establishment of model and analysis of multi-influencing factors, taking working effort as variable and through the analysis of creative value of research and development personnel, the sharing coefficient can be arrived under different situations with the sharing percentage of research and development personnel in profit stimulating their maximum contribution of intellectual capital.

Establish of basic mathematical model and hypothesis:

Suppose (hypothesis 1) when research and development personnel can create value for the enterprise, they can deduct a percentage from a sum of money. The allocating method is linear and the equation is:

$$t = (1, 2, 3... n) \tag{1}$$

In the above equation, α refers to sharing coefficient; $W_t(\alpha)$ is the bonus one research and development person can get in the year of t because of his creative activities when the sharing coefficient is α ; V_t refers to amount of bonus in the year of t . Meanwhile, suppose V is the value of creative activity by research and development person, $W_t(\alpha)$ is the money the single person can get due to his creative activity when sharing coefficient is α , i is converting rate, so:

$$w(\alpha) = \sum_{t=1}^n w_t(\alpha)/(1+i)^t = \alpha \sum_{t=1}^n V_t/(1+i)^t = \alpha \cdot V \tag{2}$$

Normally, the value created by research and development personnel creative activity will have positive correlation with their working efforts. That is, the harder the personnel work, the more value they will bring to the enterprise; meanwhile the marginal value is decreasing. Suppose (hypothesis 2) the correlation equation of the value brought to enterprise by creative activity and single person is:

$$v = m \cdot \sqrt{E} \tag{3}$$

In the equation, E refers to the level of working effort of research and development personnel engaged in creation, v represents the value created by single person to enterprise, m is the creative activity value contributing coefficient by the level of working effort. Research and development personnel will work hard in creative activities, at the same time, the effort cost should be calculated which has positive correlation with effort level. And when the effort level is increasing, the marginal cost is gradually increasing too. Suppose the effort cost of research and development personnel C (E) is equal to currency cost and suppose (hypothesis 3) the relation equation of effort cost and level is:

$$C(E) = b \cdot (E)^2/2 \quad (4)$$

In the equation, b>0 is cost coefficient, the larger b is, the more negative effect will be brought by the equal effort level E. So, the net income of research and development personnel is:

$$R(\alpha, E) = w(\alpha) - C(E) \quad (5)$$

Suppose Ψ is the bonus integration with the feature of profit-sharing received by all the research and development personnel, the net value created to the enterprise is:

$$\pi(\alpha) = V - \sum_{w(\alpha) \in \Psi} w(\alpha) \quad (6)$$

where, $\sum_{w(\alpha) \in \Psi} w(\alpha)$ represents the integration of profit-sharing received by research and development personnel contributed to value creating. From Eq. 5 and 6, it can be seen that π and R is opposite in interest. So, what should be done at present is to study under what kind of condition π and R can reach the most excellent number.

Sharing coefficient analysis of enterprise and research and development personnel engaged in creative activities:

Suppose the effort level of research and development personnel engaged in creative activities is unnoticeable and under the condition of medium risk, when the enterprise is sure of sharing coefficient as α , research and development personnel are sure that the best effort level is E* under the premise that their net income R (α , E) are at utmost. When the personnel can make sure their effort level E, suppose the enterprise also has medium risk, the enterprise can make sure the best sharing coefficient α^* according to the effort level to make the net value π (α) brought to enterprise by creative activities at utmost. So, the maximum sharing coefficient α^* can be assured by the relation of best effort level of research and development personnel E* and α .

Maximum sharing coefficient when double people engaged in enterprise creative activities:

One major and one assistant creator may appear in one scientific and technological project. The major creator is the main contributor or first creator to create value, may not be the leader of the project; the assistant refers to the creator who plays an assistant role or relatively minor role in the creation. Due to different influencing degree brought to creative value, the profit-sharing allocated by enterprise will certainly be different. Suppose (hypothesis 4) only one major creator exists in one creative project and the assistant one has no bonus and the contribution he made to the creative value can be neglected. And the value create to enterprise by creative activities is the value created by single major creator, namely:

$$V = v = m \cdot \sqrt{E} \quad (7)$$

Substitute the above Eq. 4 into 5, the net income of creator is:

$$R(\alpha, E) = w(\alpha) - C(E) = a \cdot m \cdot \sqrt{E} + y - b \cdot (E)^2/2 \quad (8)$$

The creator takes net income maximum as aim, then the excellent level of E is E*. The necessity of net income maximum at first order is:

$$\frac{\partial R(\alpha, E)}{\partial E} = \frac{1}{2} a \cdot m \cdot (E)^{-1/2} - b \cdot (E) = 0 \quad (9)$$

So:

$$E^* = (a \cdot m / 2b)^{2/3} \quad (10)$$

Substitute Eq. 10 into 7:

$$V = (m)^{4/3} \cdot (\alpha / 2b)^{1/3} \quad (11)$$

So, the net value brought to enterprise by creative activities can be calculated combined Eq. 2, 6 and 11:

$$\pi(\alpha) = V - \sum_{w(\alpha) \in \Psi} w(\alpha) = V \cdot (1 - \alpha) = (m)^{4/3} \cdot (\alpha / 2b)^{1/3} \cdot (1 - \alpha) \quad (12)$$

The enterprise is rational, so the best sharing coefficient α will be chosen under the premise of net value $\pi(\alpha)$ at utmost. The first order necessity of $\pi(\alpha)$ maximum is:

$$\frac{d\pi(\alpha)}{d\alpha} = (m)^{4/3} (2b)^{-1/3} \cdot \left[-4/3 \cdot (\alpha)^{1/3} + \frac{1}{3} (\alpha)^{-2/3} \right] = 0 \quad (13)$$

The solution of the above equation is:

$$\frac{\sqrt[3]{m^4}}{\sqrt[3]{2b}} \left[\frac{1}{3\sqrt[3]{\alpha^2}} - \frac{4^3\sqrt{\alpha}}{3} \right] = 0 \tag{14}$$

$$\frac{\sqrt[3]{m^4}}{3^3\sqrt[3]{2b}\sqrt[3]{\alpha^2}} = \frac{4^3\sqrt{\alpha}\sqrt[3]{m^4}}{3^3\sqrt[3]{2b}} \tag{15}$$

So:

$$\frac{1}{\sqrt[3]{\alpha^2}} = 4^3\sqrt{\alpha} \tag{16}$$

So, the maximum sharing coefficient of the enterprise is:

$$\alpha^* = 25\% \tag{17}$$

So, the maximum sharing coefficient when two people take part in scientific and technological creative activity is:

$$\alpha^* = 25\% \tag{18}$$

Maximum sharing coefficient when many people engaged in enterprise creative activities: The above equation is arrived when only one major research and development person engaged in creation can deduct a percentage from a sum of money, which is mentioned in hypothesis 4. If there are h main research and development personnel engaged in creative activity, will the sum of their profit-sharing coefficients be 25%?

Suppose (hypothesis 5) the sharing coefficients of the h major creators are the same and their contributions degree to the creation are also the same and independent, then the linear sum of value created to enterprise composes the value created to enterprise by creative activity, that is:

$$V = h.v (E) = h.m. \sqrt{E} \tag{19}$$

The same derivation is used to get the maximum sharing coefficient of single major research and development person, that is:

$$\alpha^*_{d1} = 1/4h \tag{20}$$

RESULTS

Then the result can be arrived, that is, when many people engage in the scientific and technological

creative activities of enterprise, the maximum sharing coefficient of single person is $\alpha^*_{d1} = 1/4h$.

So, the sum of sharing coefficients of h major creators is 25%, namely, the left and right of the above formulary multiply h at the same time to arrive at this conclusion. The conclusion can be arrived that when many people engaged in creative activity, the sum of maximum sharing coefficients is:

$$\alpha^*_d = 25\% \tag{21}$$

Value assurance of research and development personnel creative activities: When applied into reality, the key link is to judge the value created to enterprise by one creative activity and in this study one method is offered for reference:

First, the importance of creative activity of that year should be evaluated and weight number k is assigned to it. When there are not any achievements produced by creative activity, the source factors of value brought to enterprise that year by research and development personnel creative activity should be analyzed.

Then, according to the influence forces brought by creative activity, the enterprise can analyze the influence forces of every factor on the development of the enterprise the same year, evaluate the importance and then assign the weight number in accordance with certain standard. Then, in which aspects the creative activity can bring value to the enterprise should be analyzed, the weight numbers of creative activity will be accumulated and the sum is K and the proportion of every weight number should be calculated.

At last, the profit (or economic adding value) the year before of the first value factor is as a basic number P_0 , then the value brought to enterprise by annual creative activities is the subtraction of the profit (or economic adding value) this year P_n and basic number P_0 . So, the value of creative activity is:

$$V = (P_n - P_0) - \frac{k}{K} \tag{22}$$

CONCLUSION

At the five basic hypothesis as premises, after imitating the mathematical model of creative activities and taking enterprise profit maximum as purpose, the maximum profit-sharing coefficient of research and development personnel engaged in creative activities is deduced as a constant, that is the maximum sum of profit-sharing coefficient of research and development personnel takes 25% of the value brought to enterprise by creative

activities. The above coefficient is arrived only when one stimulating measure exists, namely deduction a percentage from a sum of money. However, in reality, the stimulations the enterprise has are not only profit-sharing, but also nonmaterial like position promotion and level promotion and long term like stock option, so the sum of sharing coefficient in practice will be less than 25%. The above conclusion depends on the realism of the five hypotheses which comparatively truly imitate the real situation of research and development personnel. However, errors also exist. Of course, the errors will have influence on the reliability of the above conclusion, so the influence of errors on the reliability need further study.

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