

# Evaluation on the Innovation Ability of Talent Through Extenics

## Evaluation Method\*

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**Keywords:** The talent's Innovation Ability, Matter-element model, Extenics evaluation method

**Abstract:** Using literature research, expert consultation method, the paper analyzed the elements of the talent's innovation ability, and constructed the evaluation index system including innovation thinking ability, insight, self-confidence and learning ability with 4 first level indicators and 17 second level indicators. The extension evaluation method was applied to the talent's innovation ability matter element model and an example is used to verify. The results of the study indicate that the extension evaluation method can obtain the comprehensive level of innovation ability; and evaluation results can reflect talent in different dimensions of innovation ability of the advantages and disadvantages, and provide the basis for the following targeted training program.

### Introduction

It is well known that talent is the scarce resource of the 21st century and plays an important role in the rapid growth of the world economy. As a practitioner of talent power, the innovation ability of talents is of great importance. In practice, how to evaluate the innovation ability of talents is worthy of government and academic thinking.

From the point of view of the existing literature, first of all, most of the scholars from the spirit of innovation, innovation consciousness and innovation ability three aspects to definition of innovative talents, Yurong Zhang (2006) added to the talent of innovation personality <sup>[1]</sup>, Weifa Chen (2008) highlighted the talent of professional quality and innovative quality <sup>[2]</sup>, Yabin Wang (2009) has highlighted the positive value of contribution <sup>[3]</sup>. Secondly, the definition of innovation ability is also controversial. The tassell (2006) argue that only the reservation of innovative practice with creative thinking ability is the ability to innovate, should focus on imagination, questioned the ability, memory ability, confidence and insight into the five capacity <sup>[4]</sup>. Haitao Zhao (2013) added innovative personality, innovative consciousness and innovative spirit <sup>[5]</sup>. Xiaodong Zhou (2001) has emphasized both the potential of innovation and the level of innovation. Among them, the innovation potential both considering the objective level also highlights the subjective level, the former focus on talents' learning ability, the ability to apply knowledge and practical experience, the latter focuses on the new talent initiative and ability to resist setback research <sup>[6]</sup>. Jingjie Zhao (2009) the innovative talents evaluation can be divided into the basic quality module, innovation, quality and future innovation performance module, also pay attention to the potential of innovative talents, including innovation content and effect of the two indicators <sup>[7]</sup>.

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\*Fund project: "Research on the cultivation of innovative entrepreneurial talents based on the quality model". From education science planning project of Hubei education department, China. (2016GB080)

## Index system of the talent innovation ability

### Creative thinking ability

Thinking ability is the core of creative thinking ability, namely the use of novel and unique method to solve the problem of the process of thought, it not only reveals the essence of the objective things and association, but also can further contributions have social significance, novel and original thinking. J. P. Guilford summed up the characteristics of creative thinking: fluency, uniqueness, and flexibility<sup>[8]</sup>. Fluency focuses on how much thought is present in a limited time; Flexibility focuses on the ability to discard old habits and ways of thinking and to create different ways of thinking. Uniqueness emphasizes unusual responses and the ability to break the rules, such as redefining or organizing the ability to see and hear in a new way. At the same time, creative thinking is also highly sensitive, in time to grasp the ability of novel and unique ideas. E. P. Torrance also refers to precision, emphasizing the precise details of what you think about things<sup>[9]</sup>.

### Insight

In short, insight means seeing the essence through phenomena, and Freud thinks that insight is unconscious as conscious. Therefore insight mainly emphasizes analysis and judgment, and is also a comprehensive ability. For talents, if you want to development, you should have a strong to find something new, or at least the ability to grasp the development direction otherwise can only follow others and it's hard to have a great development<sup>[10]</sup>. This article evaluates the ability of market opportunity, doubt force, imagination, rationalization proposal and product improvement ability.

### Self-confidence

Self-confidence is full of confidence when expressing an individual's opinion, and does not show negative pessimism or active aggression and manipulative behavior. For talent, self-confidence is essential, only with this ability, people can love life from the heart, desire the noble behavior, and these feelings are positive and positive. This paper evaluates from four aspects: enterprise, resilience, belief and perseverance<sup>[11]</sup>.

### Learning ability

Learning ability focuses on the ability of transforming knowledge resources to knowledge capital. The learning force not only involves the total amount of learning, i.e. the broad degree of learning content and the degree of openness and tolerance of learners; It also involves the quality of learning, namely the comprehensive quality of learners, the efficiency of learning and the quality of learning. It also involves the level of flow of learning, namely the speed of learning and the ability to expand and absorb knowledge. In particular, it is the knowledge increment of learning<sup>[12]</sup>. This paper evaluates the memory ability, learning consciousness, learning motivation and learning effect.

Therefore, this paper constructs the evaluation index system of talent innovation ability, including 4 primary indexes and 17 secondary indexes, and the specific contents are shown in table 1.

Table 1 evaluation index system of talent innovation ability

the primary index	The secondary index	the primary index	The secondary index
Creative thinking ability C <sub>1</sub>	Thinking fluency C <sub>11</sub>	Insight C <sub>2</sub>	Market opportunity grasping ability C <sub>21</sub>
	Thought uniqueness C <sub>12</sub>		Questions force C <sub>22</sub>
	Mind flexibility C <sub>13</sub>		Imagination C <sub>23</sub>
	Thinking sensitivity C <sub>14</sub>		Product improvement ability C <sub>24</sub>
	Think precision C <sub>15</sub>		
Self-belief C <sub>3</sub>	Initiative C <sub>31</sub>	Learning ability C <sub>4</sub>	Memory ability C <sub>41</sub>
	Anti-frustration ability C <sub>32</sub>		Learning consciousness C <sub>42</sub>
	Triumphalism C <sub>33</sub>		Learning motivation C <sub>43</sub>
	Perseverance C <sub>34</sub>		Learning effect C <sub>44</sub>

**Talent innovation capability extension evaluation model**

Determine the classical domain, the domain, and the evaluation element

Set up the domain of the whole formation of the evaluation talent  $\mathcal{R} = \{\mathcal{R}_1, \mathcal{R}_2, \dots, \mathcal{R}_n\}$ . Then we

evaluation to evaluate talent innovation ability respectively, set  $C = \{C_1, C_2, \dots, C_n\}$  as primary

index,  $C_i = \{C_{i1}, C_{i2}, \dots, C_{iN_i}\}$  as the secondary indexes, There are m rating scales

$N_1, N_2, \dots, N_m$ ,  $N_{ij}$  represents the  $j$  evaluation category of the primary indicators  $C_i$ , and

$N_{ikj}$  represents the  $j$  evaluation category of the secondary indicator  $C_{ik}$ ,

$V_{ikj} = \langle a_{ikj}, b_{ikj} \rangle$  represents  $N_{ikj}$  of  $C_{ik}$ 's value of the range, which is about the corresponding evaluation index selected data for every range of classic domain, and set up a corresponding classifiers with matter-element:

$$R_{i,j} = \begin{vmatrix} N_{ij} & C_{i1} & V_{i1} \\ & C_{i2} & V_{i2} \\ & \dots & \dots \\ & C_{iN_i} & C_{iN_i} \end{vmatrix} = \begin{vmatrix} N_{ij} & N_1 & N_2 & \dots & N_m \\ C_{i1} & \langle a_{i11}, b_{i11} \rangle & \langle a_{i12}, b_{i12} \rangle & \dots & \langle a_{i1m}, b_{i1m} \rangle \\ C_{i2} & \langle a_{i21}, b_{i21} \rangle & \langle a_{i22}, b_{i22} \rangle & \dots & \langle a_{i2m}, b_{i2m} \rangle \\ \dots & \dots & \dots & \dots & \dots \\ C_{iN_i} & \langle a_{iN_i1}, b_{iN_i2} \rangle & \langle a_{iN_i2}, b_{iN_i2} \rangle & \dots & \langle a_{iN_im}, b_{iN_im} \rangle \end{vmatrix}$$

$$\text{Let } R_{ip} = \begin{vmatrix} N_{ip} & C_{i1} & V_{i1p} \\ & C_{i2} & V_{i2p} \\ & \dots & \dots \\ & C_{iN_i} & V_{iN_ip} \end{vmatrix} = \begin{vmatrix} N_{ip} & C_{i1} & \langle a_{i1p}, b_{i1p} \rangle \\ & C_{i2} & \langle a_{i2p}, b_{i2p} \rangle \\ & \dots & \dots \\ & C_{iN_i} & \langle a_{iN_ip}, b_{iN_ip} \rangle \end{vmatrix}$$

$N_{ip}$  represents the whole of the evaluation hierarchy,  $V_{ikp}$  represents  $N_{ip}$ 's range of the selected value, which is the domain. To treat "q" evaluated, the data obtained by the test or the result of the analysis can be expressed as a matter element.

$$R_i = \begin{pmatrix} q & C_1 & v_1 \\ & C_2 & v_2 \\ & M & M \\ & C_n & v_n \end{pmatrix}$$

Determine the weight coefficient

This study mainly uses analytic hierarchy process to determine index weight.

Determine the relevance of the items to be evaluated

$$K_j(v_{ik}) = \begin{cases} \frac{\rho(v_{ik}, V_{ij})}{\rho(v_{ik}, V_{ip}) - \rho(v_{ik}, V_{ij})} & v_{ik} \notin (a_{ij}, b_{ij}) \\ -\frac{\rho(v_{ik}, V_{ij})}{|v_{ij}|} & v_{ik} \in (a_{ij}, b_{ij}) \end{cases} \quad (1)$$

Then,  $\rho(x, \langle a, b \rangle)$  represents the distance between the element  $x$  and the finite interval  $V = (a, b)$ . The correlation function  $K_j(v_i)$  describes the degree of attribution of the various indexes to the evaluation category  $j$ . Calculate the correlation degree of  $q$  with the first index  $C_i$  on grade  $j$ , and calculate the relative degree of  $q$  on grade  $j$ .

$$K_j(q_i) = \sum_{k=1}^{N_i} \alpha_{ik} K_j(v_{ik}) \quad (2)$$

$$K_j(q) = \sum_{i=1}^n \alpha_i K_j(q_i) \quad (3)$$

## Rating

If  $K_{j_0}(q) = \max_{j \in \{1, 2, \dots, m\}} K_j(q)$ , the rating is belong to grade  $j_0$ .

Let

$$\bar{K}_j(q) = \frac{K_j(q) - \min_j K_j(q)}{\max_j K_j(q) - \min_j K_j(q)} \quad (4)$$

$$j^* = \frac{\sum_{j=1}^m j \cdot \bar{K}_j(q)}{\sum_{j=1}^m \bar{K}_j(q)} \quad (5)$$

Call  $j^*$  the level variable eigenvalue of  $q$ .

**Application examples of talent innovation capability extension evaluation**

Determine the evaluation object

The talent innovation ability can be evaluated, and the evaluation system constructed is mainly based on talents. In this study, three science and technology talents were selected as evaluation objects from a national laboratory in the east lake high-tech zone, and the evaluation of the evaluation of talent innovation was demonstrated by extension evaluation, and the object theory field was evaluated.

**Optimal evaluation**

Determine the classical domain, the domain and the evaluation element of the talent innovation ability.

Through literature review and interview evaluation experts, the evaluation of talent innovation ability was divided into four grades, namely 4 (strong), 3 (strong), 2 (general) and 1 (poor).According to the classifications of the classical domain, the domain and the model for evaluating the innovation ability of talents, see table 2.

**Table 2: meta-model for evaluating talent**

The first index	The second Index	$N_{14}$	$N_{13}$	$N_{12}$	$N_{11}$	$N_{1p}$	q
$C_1$	$C_{11}$	<0.8, 1>	<0.6, 0.8>	<0.5, 0.6>	<0.2, 0.5>	<0.2, 1>	0.77
	$C_{12}$	<0.9, 1>	<0.7, 0.9>	<0.4, 0.7>	<0.2, 0.4>	<0.2, 1>	0.68
	$C_{13}$	<0.8, 1>	<0.6, 0.8>	<0.5, 0.6>	<0.2, 0.5>	<0.2, 1>	0.63
	$C_{14}$	<0.7, 1>	<0.6, 0.7>	<0.5, 0.6>	<0.3, 0.5>	<0.3, 1>	0.54
	$C_{15}$	<0.8, 1>	<0.6, 0.8>	<0.5, 0.6>	<0.2, 0.5>	<0.2, 1>	0.81
$C_2$	$C_{21}$	<0.9, 1>	<0.7, 0.9>	<0.4, 0.7>	<0.2, 0.4>	<0.2, 1>	0.86
	$C_{22}$	<0.75, 1>	<0.65, 0.75>	<0.55, 0.65>	<0.45, 0.55>	<0.45, 1>	0.73
	$C_{23}$	<0.8, 1>	<0.6, 0.8>	<0.5, 0.6>	<0.2, 0.5>	<0.2, 1>	0.55
	$C_{24}$	<0.8, 1>	<0.6, 0.8>	<0.5, 0.6>	<0.2, 0.5>	<0.2, 1>	0.67
	$C_{31}$	<0.7, 1>	<0.6, 0.7>	<0.5, 0.6>	<0.3, 0.5>	<0.3, 1>	0.49
$C_3$	$C_{32}$	<0.75, 1>	<0.65, 0.75>	<0.55, 0.65>	<0.45, 0.55>	<0.45, 1>	0.63
	$C_{33}$	<0.8, 1>	<0.6, 0.8>	<0.5, 0.6>	<0.2, 0.5>	<0.2, 1>	0.75
	$C_{34}$	<0.8, 1>	<0.6, 0.8>	<0.5, 0.6>	<0.2, 0.5>	<0.2, 1>	0.82
$C_4$	$C_{41}$	<0.85, 1>	<0.75, 0.85>	<0.65, 0.75>	<0.25, 0.65>	<0.25, 1>	0.66
	$C_{42}$	<0.75, 1>	<0.65, 0.75>	<0.55, 0.65>	<0.45, 0.55>	<0.45, 1>	0.73
	$C_{43}$	<0.7, 1>	<0.6, 0.7>	<0.5, 0.6>	<0.3, 0.5>	<0.3, 1>	0.57
	$C_{44}$	<0.8, 1>	<0.6, 0.8>	<0.5, 0.6>	<0.2, 0.5>	<0.2, 1>	0.81

Determine the weight coefficient of the evaluation index of talent innovation ability

Using the analytic hierarchy process, experts were organized to give scores according to the proportion of importance evaluation index scale interaction at all levels, and form a judgment

matrix according to the grading results to determine the weight of evaluation indexes at all levels, as shown in the table 3 and table 4.

**Table3 the first index weight**

Index	C <sub>1</sub>	C <sub>2</sub>	C <sub>3</sub>	C <sub>4</sub>
Weight	0.427	0.301	0.212	0.106

**Table4 the second index weight**

Index	C <sub>11</sub>	C <sub>12</sub>	C <sub>13</sub>	C <sub>14</sub>	C <sub>15</sub>	C <sub>21</sub>	C <sub>22</sub>	C <sub>23</sub>	C <sub>24</sub>
Weight	0.187	0.301	0.266	0.111	0.135	0.266	0.317	0.305	0.112
Index	C <sub>31</sub>	C <sub>32</sub>	C <sub>33</sub>	C <sub>34</sub>	C <sub>41</sub>	C <sub>42</sub>	C <sub>43</sub>	C <sub>44</sub>	
Weight	0.252	0.377	0.220	0.151	0.308	0.166	0.201	0.425	

Calculate the correlation degree of each indicator of talent innovation ability

According to the formula(1), the correlation degree of the secondary index to the evaluation level is calculated, and the correlation degree of the index C<sub>11</sub> is shown here on the grade "strong":

$$\rho(0.77, \langle 0.8, 1 \rangle) = |0.77 - (0.8 + 1) / 2| - (1 - 0.8) / 2 = 0.03$$

$$\rho(0.77, \langle 0.2, 1 \rangle) = |0.77 - (0.2 + 1) / 2| - (1 - 0.2) / 2 = -0.23$$

$$\kappa_{4(v_{11})} = 0.03 / (-0.23 - 0.03) = -0.12$$

The correlation degree of the primary index is calculated according to the formula (2) as follows:

$$K_4(q_1) = \sum_{i=1}^6 \alpha_{1ik} \times K_4(v_{1k})$$

According to formula (3), the correlation degree of "strong" grade of talent innovation ability is calculated.

$$K_4(q) = \sum_{i=1}^4 \alpha_i \times K_4(v_i)$$

In the same way, the correlation degree function value of the evaluation level is calculated, as shown in table 5, table 6 and table 7.

**Table 5 the second level index of talent innovation ability related to evaluation grade correlation function value**

The second index	K <sub>4</sub> (v <sub>1k</sub> )	K <sub>3</sub> (v <sub>1k</sub> )	K <sub>2</sub> (v <sub>1k</sub> )	K <sub>1</sub> (v <sub>1k</sub> )	The second index	K <sub>4</sub> (v <sub>1k</sub> )	K <sub>3</sub> (v <sub>1k</sub> )	K <sub>2</sub> (v <sub>1k</sub> )	K <sub>1</sub> (v <sub>1k</sub> )
C <sub>11</sub>	-0.12	0.15	0.07	-0.54	C <sub>31</sub>	-0.53	-0.37	-0.37	0.06
C <sub>12</sub>	-0.41	-0.06	-0.07	-0.47	C <sub>32</sub>	-0.40	-0.10	-0.14	-0.31
C <sub>13</sub>	-0.31	0.09	0.20	-0.26	C <sub>33</sub>	-0.17	0.25	-0.38	-0.50
C <sub>14</sub>	-0.40	-0.20	-0.53	-0.14	C <sub>34</sub>	0.12	-0.10	-0.55	-0.64
C <sub>15</sub>	0.06	-0.05	-0.53	-0.62	C <sub>41</sub>	-0.36	-0.21	0.03	-0.03
C <sub>21</sub>	-0.22	0.40	-0.23	-0.77	C <sub>42</sub>	-0.07	0.08	-0.23	-0.40
C <sub>22</sub>	-0.07	0.08	0.17	-0.40	C <sub>43</sub>	-0.33	-0.10	0.13	-0.21

$C_{23}$	-0.42	-0.13	-0.18	-0.13	$C_{44}$	0.06	-0.05	-0.53	-0.62
$C_{24}$	-0.28	0.27	-0.37	-0.34					

**Table 6: the evaluation of the function value of grade of correlation degree of evaluation of talent innovation ability**

The first index	$K_4(q_i)$	$K_3(q_i)$	$K_2(q_i)$	$K_1(q_i)$
$C_1$	-0.26	-0.24	-0.35	-0.15
$C_2$	0.00	0.12	-0.22	-0.22
$C_3$	-0.09	-0.10	0.22	-0.18
$C_4$	-0.41	-0.41	-0.23	-0.36

**Table 7: The ability to evaluate the degree of correlation function of evaluation**

Talent	$K_4(q)$	$K_3(q)$	$K_2(q)$	$K_1(q)$
$R_1$	-0.17	0.25	-0.20	-0.27

Evaluate the innovation ability of talent

According to formula (4) and (5), the characteristic value of the talent level is calculated:

$$\kappa_{j_0}(q) = \max_{j=1,2,3,4} \kappa_j(q) = \kappa_3(q)$$

$$\bar{\kappa}_4 = (-0.17 + 0.27) / (0.25 + 0.27) = 0.19$$

$$\bar{\kappa}_3 = 1, \bar{\kappa}_2 = 0.13, \bar{\kappa}_1 = 0,$$

$$j^* = \frac{4 \times 0.19 + 3 \times 1 + 2 \times 0.13 + 1 \times 0}{0.19 + 1 + 0.13 + 0} = 3.05$$

The innovation abilities of other talents were evaluated according to the same method, and the evaluation results were shown in table 8.

**Table 8 evaluation result of talent innovation ability**

Talents	$K_4(q)$	$K_3(q)$	$K_2(q)$	$K_1(q)$	$j_0$	$j^*$
$R_1$	-0.17	0.25	-0.20	-0.27	3	3.05
$R_2$	-0.45	-0.12	0.09	-0.34	2	2.23
$R_3$	-0.58	-0.26	-0.07	0.04	2	1.79

From the above evaluation, it can be concluded that the innovation ability of  $R_1$  is better than the other two, and the rating is "stronger" and the characteristic value of the level variable is 3.05. The innovation ability of this talent is "stronger" and "strong". In the same way, we can evaluate the innovation ability of this talent. Evaluation result, the innovation ability of creative thinking ability, insight and learning ability evaluation grades are "strong", among them, the vision and ability to learn to "strong", and the evaluation of self-efficacy level as the "general", but to "strong". In  $R_2$  and  $R_3$ , the evaluation level of innovation ability is generally "general", compared with the "weak"  $R_3$ .

**Conclusion**

This study analyzes the innovation ability of components, from the creative thinking ability, insight, self-efficacy and learning ability of four dimensions, talent innovation ability evaluation index system is constructed. On the basis of the theory of extenics, build the matter-element model of talent innovation ability, talent innovation dynamic evaluation model is established, from the

perspective of qualitative and quantitative comprehensive considering the characteristics of the talent innovation ability, innovation ability for scientific evaluation of talent. By using the extension evaluation method to the east lake high-tech zone a national laboratory innovation capability evaluation of talent R1, proved that the extension evaluation method can reflect the comprehensive level of talents' innovative ability, and can focus on the "horizontal" level of the evaluation of different dimensions. The research conclusion can help to clarify the ability of talents to innovate, and to strengthen and improve the innovation ability of talents through targeted training programs.

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