Research on the Selection Method of the Key Factors of Engineering Doctoral Training Program Based on Vague Value

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Abstract— **Engineering doctoral training program is a prerequisite for the cultivation of high-level engineering and technical personnel. In recent years, domestic engineering doctoral pilot colleges and universities continue to improve the engineering doctoral training program, and enhance the degree of personalized and professional doctoral training. To this end, the key factor in the engineering training program has become the focus of Scientific and rational formulation of engineering doctoral training program at the pilot colleges and universities. However, at present, there is a lack of relevant research results at home and abroad. In this paper, we build the influence factors of engineering doctoral training program based on Vague set, and we have studied the selection method of project training program selection method key factors.**

Index Terms—**Vague Set, Engineering Doctor, Training Program.**

I. INTRODUCTION

At present, how to solve the problem of the lack of high level technical talents in China is the most important part of China's enterprises to improve the international competitiveness. However, with the steady growth of the economy, science and technology plays an indispensable role in promoting economic and social development. Therefore, cultivating high-level engineering and technical personnel and the related field of high-end leading talent, are the most urgent task in front of China's higher education project.

At the twenty-eighth meeting of the Council of the State Council in 2011, the setting up of a doctoral degree was approved, and the types of postgraduate education in our country have made new breakthroughs. In order to cultivate the compound talents which can improve the national innovation ability, the Education Department of our country revised and perfected the training plan.

Doctor of engineering culture should adhere to the build quality of the route, including student selection; curriculum setting; the setup of teachers; tutor students ability and so on, so as to achieve selects the high quality of students, to develop personalized curriculum, select the key research subject has been obtained the best harvest. To cultivate high quality graduate and doctoral students, we must develop a scientific training plan. Through the training program for training objectives, enrollment objects, training method, course

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offered, achievements in scientific research and dissertations, and six main researches and innovation, so as to achieve the overall goal.

So the evaluation and innovation of the engineering doctoral training program have become the focus of the pilot training.

II. ESTABLISHMENT OF KEY ELEMENTS OF ENGINEERING DOCTORAL TRAINING PROGRAM

In November 2013, the Ministry of education proposed 《the general standard for the education and training program of the outstanding engineers》. For engineering doctoral training program put forward more professional requirements. At present, the pilot colleges and universities to meet the social demand for engineering, as a starting point innovative training program, improve the engineering doctoral training system, to ensure the quality of training has a great challenge.

A. Establishment of Key Elements of Engineering Doctoral Training Program Submit your manuscript electronically for review.

The needs of society to the engineering doctor created the engineering doctoral training target. The training objectives of the project are: (1)The engineering doctoral training must be originality and can make contribution in the corresponding engineering domain and enterprise development; (2)The engineering doctoral training can quickly and sharp insight into the progress of engineering technology, and can exert influence; (3)The engineering doctoral training need Have the potential and quality of being a professional leader and organizer, and can adapt to the rapid changes in the market and change the ability of enterprise production. (4)The training needs of the project are to meet the needs of major scientific and technological projects as a guide, to accurately grasp the forefront of the development of the field, the training of the elite.

In the enrollment object, the students should have a master's degree and have a better theoretical basis and practical ability, and have good plasticity.

Training methods and curriculum needs to meet the training objectives, to reflect the comprehensive, professional, practical features. In order to achieve the goal, the university must innovate in the way of engineering doctoral training mode, change the traditional teaching method of academic graduate students, the demand of the industry, the innovation of curriculum system structure, strengthen the learning of practical courses, and optimize the setting of the curriculum. Engineering doctoral training should reflect the idea of "precision manufacturing", to

achieve "high end order" training.

Degree thesis is the most basic standard to evaluate the scientific research level and professional ability of doctoral students, and is an important symbol to measure the quality of postgraduate training. Therefore, colleges and universities should pay attention to the engineering doctoral degree thesis.

To sum up, the higher engineering education training key scheme is affected by many factors. This paper on the establishment of engineering doctor training scheme of key factors in the process, reference 25 pilot colleges of engineering doctor recruit students general rules, gets a relatively complete engineering doctor training scheme of key factor index. The following table 1.

Table 1. Key Elements of the Engineering Doctoral Training Program

	key element name		key element name
Training target	1 Degree of satisfaction to society 2 full development of the character 3 Cultivate the ability to work independently in scientific research 4 Team spirit 5 ability to communicate 6 Innovation ability	Course setting	12 modularization curricular system 13 Comprehensive degree of industrial university research 14 Individualized training plan
Enrollment object	7 Master's degree has been obtained. 8 Theoretical basis of Engineering Technology	Scientific research achievements	15 Meet the development needs of Engineering
Cultivation method	9 Explicit assessment method 10 coalition of college and enterprise; 11 Cultivation of engineering practice ability	Degree thesis	16 Reflect the theoretical basis of Engineering 17 Practical application value

B.   Key Elements Index System Establishment

A lot of research shows that the more factors that affect the negative impact of the cumulative error and the independence of each index, we must set up a key index system in the evaluation index of 17 engineering doctoral training programs, which is based on table 2-1.

For the selection of key indicators, the traditional approach is to make all of the experts to make a ranking of the importance of the above 17 indicators, and then gather the preferences of experts to form a group, according to the group preference ranking key indicators. However, in order to avoid the difficulties and contradictions of the large sample scoring and ranking, this paper proposes a selection method based on Vague set, which can reflect the judgment that every expert has a more intuitive meaning, which is more intuitive and easy to use.

First, the basic concept of Vague set, i.e.

Definition 1 Let U be a non-empty set, element $x \in U$, U on a Vague set A is a pair of U on the tA and fA, that is,

$$t_A : U \rightarrow [0,1], \qquad f_A : U \rightarrow [0,1]$$

Meet $t_A(x) + f_A(x) \leq 1,$ and $0 \leq t_A(x) \leq 1$, $0 \leq f_A(x) \leq 1$.

Among them, the tA is used to express the membership degree of the supporting evidence. fA, for the Vague set A the false membership function, representing the lower bound of the membership degree of the evidence against $x \in A$.

Definition 1 Vague on the domain U is x= $[t_x, 1-f_x]$. Among them $t_x \in [0,1], f_x \in [0,1], t_x + f_x \leq 1$, Kernel function S（x）is $S(x) = t_x - f_x$, $S(x) \in [-1,1]$.

Then, the specific steps of the selection method based on the Vague set are as follows:

(1) The expert evaluation. Please n experts for each indicator xi the importance of judgment. That will seriously affect the performance of painting "√". That will not seriously affect the performance of the painting "×" that cannot be judged by painting "○". (n=10, i=1, 2,……, 24)

(2) The calculation of the value of the true membership function tA and the false membership function fA.

The relationship between U and the key index set A is   that a Vague set. tA(xi) indicates that the indicator xi "will seriously affect the performance of engineering doctoral". fA(xi) indicates that the indicator xi "will not seriously affect the performance of engineering doctoral".

tA(xi)= the number of experts that think xi affects seriously / the number of experts n

fA(xi)= the number of experts that think xi affects is not seriously / the number of experts n

Meet the definition 1 is , and .

(3) Determine the value of the nuclear function SA(xi).

Here SA(xi) indicated the proportion of that the number of experts, which the impact of the index xi is serious more than the impact of the index is not seriously, to the total number of experts, reflecting the indicators xi is "critical elements of engineering doctoral training program" reliability, the greater SA(xi), the greater the reliability, and as a follow-up of the weight.

At the same time, given the importance index α（0<α<1）, when SA(xi)$\geq \alpha$, xi selected set of key index A. In this paper, we take the α=0.4, namely we think the proportion of that the number of experts think have seriously affect to the performance more than the number of experts think have not seriously affect is 0.4 or more, xi selected key indicators set.

This paper selects 10 experts Table 1 in 17 indexes important degree to judge, and then follow the steps above selected seven indicators marked with **, as showed in Table 2.

III. CONCLUSION

Through the use of Vague set theory, seven key factors are

selected from the seventeen comprehensive project evaluation, and the evaluation of key factors, the satisfaction degree and the team spirit is the important indicator of the training objectives, and the theoretical basis of engineering technology is the important performance of students; The cultivation of engineering practice ability in the cultivation method, the modular curriculum system, and the practical application value in the thesis.

In the study of the evaluation index of the project, it is often impossible to use a clear and definite language, so we consider the evaluation of the key indicators in the Vague set. In this paper, there are some imperfections in the research on the problem of the cultivation of the students' training scheme.

Table 2. Selection of Key Factors Based on Vague Set

指标 / 专家	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	√	√	○	×	○	×	√	√	√	×	√	√	○	○	√	√	×
2	√	○	√	○	√	√	○	√	○	√	√	√	×	√	×	√	×
3	√	×	○	√	×	√	√	○	√	×	√	○	√	×	√	√	√
4	√	√	√	○	○	○	√	√	×	√	○	√	√	√	×	○	√
5	×	○	×	√	○	√	√	×	√	√	○	○	○	×	√	×	√
6	√	√	√	○	√	√	√	√	√	×	√	√	√	×	√	√	√
7	√	×	√	√	×	○	○	○	×	×	√	√	×	○	○	○	√
8	√	○	×	√	○	√	√	×	√	√	×	×	√	√	×	×	○
9	√	√	○	○	√	×	√	√	√	○	√	√	×	×	○	○	○
10	○	√	√	√	×	○	×	√	×	×	√	√	√	○	×	○	√
√	8	5	5	5	3	5	7	6	6	4	7	7	5	3	4	4	6
○	1	3	3	4	4	3	2	2	1	1	2	2	2	3	2	4	1
×	1	2	2	1	3	2	1	2	3	4	1	1	3	4	4	2	2
$t_A(x_i)$	0.8	0.5	0.5	0.5	0.3	0.5	0.7	0.6	0.6	0.4	0.7	0.7	0.5	0.3	0.4	0.4	0.6
$f_A(x_i)$	0.1	0.2	0.2	0.1	0.3	0.2	0.1	0.2	0.3	0.4	0.1	0.1	0.3	0.4	0.4	0.2	0.3
$S_A(x_i)$	0.7	0.3	0.3	0.4	0	0.3	0.6	0.4	0.3	0	0.6	0.6	0.2	-0.1	0	0.2	0.4
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