Research on the Construction of General Competency Model for National Defense Science and Technology Talents--From the Perspective of Talent Training in National Defense Science and Technology Universities

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Abstract: As the main force to promote the development of national defense science and technology industry with Chinese characteristics, the talents of national defense science and technology urgently need to be fully selected, evaluated and cultivated. Based on the competency theoretical model, this paper proposes hypotheses via research methods such as literature survey method, expert interview method and questionnaire survey method as well as make survey on defense science and technology enterprises and research institutes through questionnaires. Through data processing and verification of 462 valid questionnaires, this study constructs the general competency model of national defense science and technology talents in 5 dimensions and 28 items, so as to provide reference for the talent training of national defense science and technology universities.

Key words: National Defense technology Talents; General Competency; Talent Development in University Education

1 Introduction

As a strategic industry of the country, defense science and technology industry is an important pillar of national security and national defense construction. It is of great significance for supporting the construction of national defense forces, promoting the progress of science and technology and serving the development of economy and society. The talents of national defense science and technology, the main force to promote the development of national defense science and technology industry with Chinese characteristics, urgently need to be fully selected, evaluated and cultivated.Now the talent pool in China's defense science and technology industry is stable on the whole, but there is still a gap between China and the world's advanced level and the current task

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requirements.As a knowledge-intensive and technology-intensiveindustry, defense science and technology industry must place training and bringing up high-quality talentson a strategic position.

<*Outline of the National Medium and Long-term Plan for Education Reform and Development (2010-2020)*>has placed the improvement of the quality of talents training at the core of the reform and development of higher education. Universities are the core of cultivating outstanding national defense science and technology talents and building outstanding national defense characteristic disciplines. It conforms to the major national strategy and the demand of social development, and undertakes the special mission of cultivating and conveying high-quality talents for national defense science and technology industry.College graduates are valuable human resources. Research on the general competency of talents can accurately grasp the requirements of the national defense science and technology industry, helping graduates quickly adapt to their own work as well as enhancing the sense of professional identity. It also plays a key or even decisive role in reducing the turnover rate after entering the company. In the long run, it is of great significance for national defense science and technology universities to improve the quality of personnel training and to train high-quality innovative talents for the construction of first-class national defense science and technology industry.

1.1 Theoretical Background

Competency from Latin ‘Competere’, can be understood as quality, ability, ability, competence and competence characteristics. Competency model is created for a field description of ability quality requirements, not only focus on traditional college education attaches great importance to professional, knowledge, skills, etc., it pays more attention to items to help make career and realizing the sustainable development, such as values, attitudes, morality, personality, motivation, etc. [1].

Since Mcclelland[1] defined this concept in 1973, the theoretical research and application of competency model became popular all over the world.As an important tool of talent evaluation, competency model has been paid much attention and studied by domestic and foreign scholars. Scholars have conducted extensive discussions on the basic connotation, evaluation method and evaluation model of competency model, and made numerous achievements.In order to enhance the scientific nature of revealing competency characteristics, Meclelland[1] put forward the behavioral event interview method and six principles of effective competency test with the open behavior retrospective exploration technology, forming a relatively perfect theoretical framework.In the 1980s, British scholars began to study and apply the competency model.Since the 1980s competency has been used in a frenzy in western countries, and Raven[2] has brought competency into the field of practitioners.At the research method level, American scholars represented by Mcberpany pay attention to the attribution method, that is, they infer the competence of high performers from their behaviors.British scholars such asMeverSemark tends to infect the performance, namely they are more inclined to think that the behavior required by effective work is important, rather than the underlying attribution.In the aspect of model construction, Spencer et al. [3] proposed the

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TheIeebergModel and TheonionModel, which have been widely applied and are the most classical. The TheIeebergModel divides human competence into two parts and points out that what is difficult to develop are the factors hidden below the water surface, such as: motivation, traits and self-concept etc.TheonionModel re-divides them into three parts based on the TheIeebergModel. The onion surface includes knowledge and skills, which are quite easy to develop;The onion includes social roles or values, and self-concept;The onion contains traits and motivations that are difficult to learn and evaluate.Both models are suitable for practical applications to help managers effectively "select" competent people.Morrison[4] discussed the role of competency model in human resource recruitment, and explored how to use competency model to select talents by analyzing the company's sales crisis caused by the sales director's wrong decision in BarkerFoods.Mark Brundertt[5] introduced the competency model into the selection and career planning of principals, emphasizing the scientificity and rigor of the competency model.

In recent years, the application of competency model has been gradually extended to more fields.Andreas Schulz(2020) et al. [6] used competency model to describe students' operational awareness from four different levels, which is a new attempt of competency model.RemigiuszSmolinski et al. [7] proposed a negotiation performance evaluation model based on the competency model, which is committed to helping scholars design more effective negotiation courses and more fair negotiation competitions.This model further enriches the role of the competency model and provides a strong basis for negotiation courses and negotiation competitions.Elizabeth O. Crawford et al. [8] used the competency model to manage team members effectively and proposed the main abilities that managers should have, which provided support for job analysis, recruitment, assessment, training and motivation, and became the new basis of modern human resource management.

Most of the existing researches in China discuss the competency characteristics based on job position from the perspective of enterprise management and human resource management, such as the competency model of different groups such as managers and entrepreneurs. Based on China's national conditions and social development conditions, the practical application of the competency model is further discussed.For example, Meng Wang [9] has completed the construction and application of competency model for enterprise managers. Yuexing Hu [10] constructed the competency model of civil servants at different levels. ZuoxueLi et al. [11] constructed the general competence model of general aviation talents.The general competency model is also used in some related researches on the background of national defense.For example, Dayan Li and AnyuWang[12] designed the evaluation dimension of management personnel's ability in line with the attributes and characteristics of national defense science and technology industry units, and Zhengyu Cao andShouhua Zhang[13] constructed the competency model of military construction project managers in universities.In recent years, competency model has been gradually applied to performance

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evaluation.JiongWang[14] constructed a strategy-based competency model and introduced the application of this model in enterprise performance management from the aspects of content, effect, follow-up plan, etc.QiongZhang[15] took the education industry as an example to discuss the relationship between competency evaluation and performance evaluation and its application.Based on the survey data of five western provinces, Zhuo Wang et al. [16] constructed and tested the competency model of village cadres through the method of behavioral event interview, combined with factor analysis and structural equation model, and discussed the relationship between the competency of village cadres and village governance performance.

1.2 Research Questions

Scholars domestic and international have carried out abundant research on the construction of competency and its related models, and some achievements have been made on the competency model of leaders in some units related to defense science and technology. However, in the aspect of talent training in defense science and technology universities, relevant research work still needs to be carried out.The defense science and technology industry also has its particularity. It is of great significance to construct the competency model from the perspective of talent training in defense science and technology universities for personnel training, management, assessment and selection.

In terms of industry characteristics, DayanLi and AnyuWang[12] believed in their research that compared with other units, national defense science and technology industrial units should have a generalized ability or combination of capabilities, including cognitive ability, operational ability and social ability.Their practical intelligence and their special abilities which are highly consistent with industry and professionalism are the key points of their evaluation.Zhengyu Cao and ShouhuaZhang[13] analyzed the characteristics of military construction project management in collegesand believed that the construction and implementation of the project had the characteristics of complex management process, great pressure of personnel communication, great technical innovation and high demand for professional quality.Zuoxue Li et al. [11] put forward five quality requirements for such talents in terms of consciousness, knowledge, ability, body and mind, and moral character when considering the characteristics of general aviation talents in China.The research objects of these studies are all professionals or managers in specific positions, not including the competency research of students in national defense technology universities.

Student group is the research object mentioned by Mcclelland in his classic article proposing the concept of competency [1].Based on the actual needs of the current national defense science and technology personnel training and the special requirements of the industry, this study solved the specific problems of what kind of personnel should be selected for the national defense science and technology industry and how to carry out personnel training in national defense science and technology universities according to the corresponding requirements of personnel quality and ability.Through empirical research, the general competency model of national defense science and

technology talents is constructed, which provides empirical basis for improving the quality of personnel training in national defense science and technology universities.

The general competence defined in this study means that the graduates trained by the school have a solid knowledge system, sound personal characteristics, good professional attitude, etc., and can be qualified for all kinds of entry-level positions in the field of defense science and technology.Based on the research results of domestic and foreign scholars, this research focuses on the general competency factors of defense science and technology industry, in order to obtain the important competency characteristics of these positions. It can not only deeply grasp the expectations of employers and the demand for talents, but also objectively evaluate the achievement degree and quality level of talents training in universities, so as to solve the output problem of the "product" of graduates of national defense science and technology universities from the perspective of supply side and demand side.

2 Research Method

According to the usual strategy, the construction of the competency model is achieved through a top-down approach [18]. Therefore, the goal of this study is to cultivate talents for assistant defense science and technology.Since the beginning of competency research, there has been no fixed measurement content of competency, but it is adjusted according to the specific objectives of the organization. Local teams carrying out competency research are also constantly expanding the research field of competency by using the general key method of building competency model [19].Competency research has a set of standardized operation procedures, which are continuously summarized and refined by domestic and foreign scholars in various fields of competency research. Table 1 shows the domestic and foreign research important competency approach, competency model building constantly get rid of traditional test model, with scientific attitude to the specific structure of the competency model constantly optimized, and the study of different objects to form a specific competency model, for related organizations or units to carry out the talent training and related work.

Table 1Main research methods of competency domestic and foreign[2]

Author	Measuring Tools and Methods	Research Method	Research Contributions
Mcclelland	Competency test	Behavioral Event Interview	Six important tests and content specifications are proposed to avoid the disadvantages of traditional tests.

Richard Boyats	Manager competency test	Competency Model Method [20]	Six main test dimensions are summarized: general knowledge, motivation, traits, self-impression, social role and skills.
ChongmingWang, MinkeChen	Management comprehensive quality key behavior evaluation scale	Comprehensive theoretical analysis, interviews and the basis of previous research	It is pointed out that competency consists of two parts: management quality and key management skills.
Zhengyu Cao, Shouhua Zhang	Competency model of military construction project managers in universities	Theoretical analysis and questionnaire survey	It is found that the competency model of military construction project managers in colleges and universities, which consists of knowledge reserve and accomplishment, personality and professional characteristics, project management ability, communication and coordination ability, and innovation ability, is statistically effective.

Kan Shi[21] summarized the research methods of competency model into seven steps in total: development strategy survey, O*NET job analysis, questionnaire survey and interview, competency coding, construction of competency model and formation of application suggestions.In the competency coding stage, a key technique is to combine the existing research "competency coding dictionary" to form a preliminary competency coding dictionary.This is the key technology to construct the specific index of competency model measurement, and reflects the characteristics and prospects of competency research itself.

Therefore, the basic methods used in the construction of competency model include behavioral event interview, literature analysis, job analysis, expert evaluation, questionnaire survey and so on.In this paper, the general competency model of defense science and technology industry is constructed by referring to existing research methods and combining the current development background, development strategy and actual talent demand of defense science and technology industry.

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2.1 Structural Hypothesis

The first step is to use the literature survey method to search and consult the domestic and foreign database literature and relevant books on competency, and find the existing research results as the reference basis.With the help of competency dictionary and the characteristics of defense science and technology industry, 28 items representing the general competency of defense science and technology talents are preliminarily sorted out.

The second step is to invite 8 career guidance teachers of national defense science and technology universities and 7 human resource experts from national defense science and technology enterprises and research institutes to discuss the general competency and quality characteristics of national defense science and technology talents in the way of expert discussion, and finally summarize 31 projects.

In the third step, an open questionnaire survey was conducted to conduct written interviews with relevant personnel from 10 defense science and technology enterprises, and 35 general competency indicators of defense science and technology talents were collected.

Based on the above three methods, the collected items are filtered, classified and combined to conclude 28 high-frequency competency items.These items were preliminarily summarized into five dimensions of background factors, knowledge structure, personal needs, basic abilities and professional qualities by the attribution method, and the basic structural assumptions of five dimensions and 28 items of general competence of national defense science and technology talents were formed.

2.2 Questionnaire Preparation

The general competence questionnaire of national defense science and technology talents is designed, 28 items are randomly arranged, and the importance of competency items is evaluated by grade description method. The grade description method adopted in this paper is the three-scale method of triangular fuzzy number.

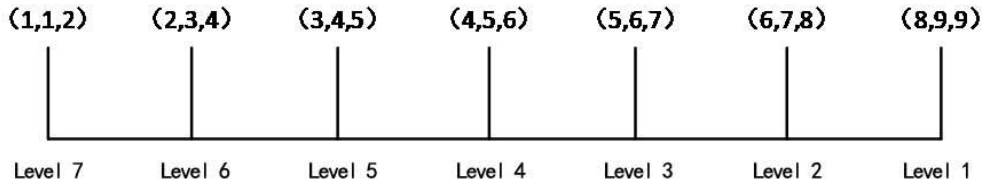

Fig.1Three scale method of triangular fuzzy number

The index of each level is expressed by the hierarchical description method, and then quantified by triangular fuzzy number.

The qualitative index is quantified into trigonometric fuzzy number, and then the trigonometric fuzzy number is transformed into clear value according to the formula to make it quantified and convenient for data calculation.If the triangle fuzzy number$N = (x, y, z)$, where $0 < x \leq y \leq z$, the

clear value of triangular fuzzy number$N^{'} = (x + 2y + z)/4$. Therefore, the evaluation level can be obtained:

$$V = \{8.75(\text{Level } 1), 7(\text{Level } 2), 6(\text{Level } 3), 5(\text{Level } 4), 4(\text{Level } 5), 3(\text{Level } 6), 1.25(\text{Level } 7)\}$$

Delphi method is used to interpret and accurately define the connotation of each index in the questionnaire, and a brief description is used to make the questionnaire brief, clear and easy to understand.

2.3 Questionnaire Distribution and Collection

In this study, five national defense institutions were selected to conduct a preliminary questionnaire survey. Based on the survey results, the questionnaire was revised again, and the final questionnaire was combined offline and online to conduct a questionnaire survey on the employers who carried out campus recruitment activities for graduates of 2020 in a national defense technology university. The main measured objects are the management personnel of human resources department in defense science and technology units.The collection time span is from September 2019 to March 2020. The samples cover defense technology enterprises and research institutes in aviation, aerospace, civil aviation, aero engine, shipping, weapons, nuclear industry and other defense technology enterprises. A total of 585 questionnaires were issued, 523 questionnaires were collected, and 462 questionnaires were valid after screening and eliminating unqualified questionnaires. The recovery rate and effective rate were 89.32% and 78.97% respectively. The sample distribution is good and meets the expected requirements of research data collection.

3 Results

3.1 Reliability and Validity Test

Before data analysis, Cronbach's α value was calculated to test the reliability, and KMO value and Bartlett value were calculated to test the validity of the questionnaire.If the Cronbach's α value does not exceed 0.6, it is considered that the internal reliability is insufficient. When it reaches 0.7-0.8, it indicates the scale has considerable reliability. When it reaches 0.8-0.9, it indicates that the scale has great reliability.If the value of KMO is not less than 0.7 and the Bartlett test value is less than the recommended significance level α = 0. 05, it indicates that the data is suitable for factor analysis.By testing 28 secondary indexes in the evaluation scale, the results are as follows: Cronbach's α value is 0.874, KMO value is 0.921, and Bartlett value is significantly different from 0, indicating that factor analysis can be performed on this scale.

3.2 Structure Verification

In this study, SPSS 24.0 was used for statistical processing of sample data.In addition, this study also uses principal component analysis to carry out exploratory factor analysis to extract common factors.In the questionnaire, measuring the national defense science and technology talent general competency quality projects, a total of 28, one of the five components of the initial eigenvalues

greater than 1, the cumulative contribution rate is more than 62%, and 28 projects are distributed in the corresponding main factor, and summarize handled in this set of model structure highly fit, also once again to verify the rationality of the design of the questionnaire and adequate reliability.By analyzing the specific items contained in the five main factors as well as the contents and characteristics of the general competence of national defense science and technology talents embodied in these items, we identified the five main factors as core competence factor, achievement motivation factor, knowledge structure factor, professional accomplishment factor and background factor in turn.

The five-dimensional model of general competency in the defense technology industry is shown in Figure 2.

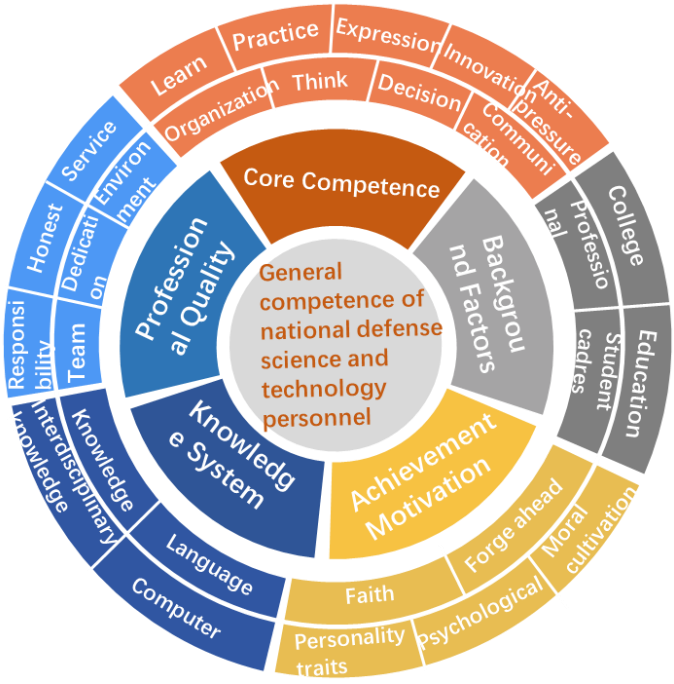

Fig. 2 Five-dimensional model of general competency in defense technology industry

The characteristic value and contribution rate of the load factor after rotation are shown in Table 2

.Table 2. Characteristic value and contribution rate of general competency

No.	Factor Name	Eigenvalue	Contribution Rate (%)	Cumulative Contribution Rate (%)
Y1	Core Competence	6.589	18.679	18.679
Y2	Achievement Motivation	6.157	17.862	36.531
Y3	Knowledge System	5.312	11.395	47.936

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Y4	Professional Quality	3.612	9.788	57.724
Y5	Background Factors	2.124	5.134	62.858

According to the characteristic value and contribution rate of general competence, it can be seen that core competence is the key factor affecting general competence of defense science and technology industry.The second is "achievement motivation", which indicates that belief in national defense is the most important factor in defense science and technology industry.The third is "Knowledge System", which adapts to the development trend of modern national defense technology and requires a scientific, reasonable, extensive and solid knowledge structure.Professional Quality came in fourth, with the defense technology industry placing the least emphasis on "Background Factors."

3.3 Project Analysis

The five principal factors are the main factors representing the general competence of national defense science and technology talents, which all include several specific projects. Further in-depth analysis of these principal factors can explore the specific impact of different projects on the general competence.

Core competencies are the basic competencies that individuals can succeed in their career. Core competence factors are composed of 9 items, as shown in Table 3. It mainly reflects the importance that the defense science and technology industry attaches to the learning, expression, innovation and other abilities of the recruits. These abilities are formed in long-term education, learning and practice, and are the key points of personnel training in universities, as well as the key points of personnel evaluation by employers.

Table 3 Core competency factors

Items	Eigenvalue
Learn	0.868
Practice	0.770
Expression	0.713
Innovation	0.724
Anti-pressure	0.517
Organization	0.494
Think	0.379
Decision	0.374
Communication	0.344

In the "Core Competence" factor, the top three eigenvalue are abilities of "Learning ", "Practicing" and "Innovation ", indicating that the defense technology industry needs talents with

broad knowledge, strong practical ability and strong change thinking. At present, seizing the opportunity of scientific and technological development, accelerating the pace of scientific and technological development, and improving the ability of independent innovation have become the common consensus of all countries in the world in the development of national defense. High-level talents are conducive to the promotion of technical exploration and field innovation in the defense science and technology industry, which requires universities to take the improvement of students' professional skills and practical ability as the main goal of talent training.

Achievement motivation is the inner power of thought and action, and has an inner driving effect on one's career.The achievement motivation factor is composed of five items, as shown in Table 4, which mainly reflects the importance that the defense science and technology industry attaches to individual ideal belief, competition and progress, personality characteristics, etc.National defense is the guarantee of a nation's survival. To select the talents suitable for national defense, we must investigate and understand the achievement motivation.

Table 4 Achievement Motivation Factors

Items	Eigenvalue
Faith	0.734
Forge ahead	0.642
Personality traits	0.633
Psychological	0.580
Moral cultivation	0.513

Among the factors of achievement motivation, the top four characteristic values are Faith, Forge ahead, Personality traits and Psychological. At a time when the international situation is changing and the conflicts in the world military field are becoming more and more acute, the talents of defense science and technology must firmly adhere to the right political direction. We always adhere to the core values of "national interests first" and the faith of "giving everything to the people". Maintaining political resolution in the history, which is also an important part of demonstrating the strength of national defense technology and industry. In view of the complexity, urgency and variability of the development of national defense science and technology, it is necessary to have the personality characteristics and psychological quality of being able to anti-pressure, withstand setbacks, be firm and patient, be brave in competition and be proactive.

Knowledge system is the proportion, correlation and configuration of individual knowledge. It is the basis for job seekers to be competent for jobs, and it affects the direction and level of graduates' employment. Employers can measure and assess by means of resume screening and professional examination. The knowledge system factor is composed of four items, as shown in

Table 5, which mainly reflects the importance that the defense technology industry attaches to knowledge, interdisciplinary knowledge, language and other kinds of knowledge.

Table 5 Knowledge System Factors

Items	Eigenvalue
Knowledge	0.734
Interdisciplinary knowledge	0.682
Language	0.607
Computer	0.494

In the knowledge system factor, "knowledge" and "interdisciplinary knowledge" ranked first and second.On the one hand, modern professional basic knowledge is the guarantee of the steady development of career, national defense science and technology talents must have scientific thinking methods and knowledge system, ability to deeply grasp knowledge and independent acquisition of new knowledge.On the other hand, with the development of science and technology and the progress of society, the emergence of any new theory and new technology cannot be separated from the integration of multidisciplinary achievements.Modern national defense science and technology is a leading industry integrating multi-disciplinary knowledge and technology, which is also based on the research results of basic science.Therefore, the defense technology industry must keep up with the current requirements of knowledge integration and technology integration, and pay attention to the ability of talents to integrate knowledge system "across disciplines".

Professional quality refers to the internal norms and requirements of the profession, and is the behavior standard that individuals need to abide by in social activities. The national defense cause is related to national security and national defense secrets, and the workload, pressure and work intensity are high. It requires that the recruits must have high professional quality. Professional quality is composed of six items, as shown in Table 6, which mainly reflects the importance that the defense technology industry attaches to individual sense of responsibility, team spirit, honest and other aspects.

Table 6 Professional Quality Factors

Items	Eigenvalue
Responsibility	0.823
Team spirit	0.790
Honest	0.714
Dedication	0.549
Service	0.689

Environment	0.567

Among the factors of "professional quality", " responsibility", "team spirit", "honest" and "dedication" ranked the top four.First, they must have a high sense of social responsibility and be determined to work hard for the modernization of national defense, the prosperity of the country and the prosperity of the people. Secondly, "team spirit" is particularly important for the defense science and technology industry, especially in some major basic research, key technologies and major engineering fields, which must require strong team cohesion and centripetal force. Finally, with a strong sense of "integrity" and "professional ethics" of national defense science and technology talents have a strong organizational discipline, can always put political security in the first place, more consciously and firmly safeguard national interests.

Background factors are the prerequisite of general competence in the defense science and technology industry, and the prerequisite for the preliminary selection of recruits in the defense units. Background factors are composed of four items, as shown in Table 7, which mainly reflect the importance that the defense technology industry attaches to factors such as the college, educational and professional background of the recruits.

Table 7 Background Factors

Items	Eigenvalue
College	0.782
Education	0.647
Professional	0.574
Student cadres	0.492

In the "background factor", the two items with the highest eigenvalue are "college" and "professional background". For the defense science and technology industry, most talents are recruited from defense science and technology colleges and universities with the same majors based on the particularity of the industry and the relevance of majors. Therefore, more attention is paid to the comprehensive strength, industry background and major setting of universities.

4 Discussion

With the improvement of the absorption capacity of national defense science and technology industry talents, the cultivation of national defense science and technology industry talents has become a complex proposition that takes into account the integration of ideological vision, scientific and technological knowledge, core quality and management practice. For universities of national defense science and technology, dynamically adapting to the change of strategic demand of national defense science and technology and deeply grasping the talent demand of industry are the path

guidance to clarify the orientation of university talent training.

First, optimize the training model of personnel with national defense characteristics. According to this study, "core competence" is the most critical factor affecting general competence in defense technology industry. For national defense science and technology industry, the demand of new military revolution under the connotation of talents characteristics had the profound change, for sake of national security and defense equipment modernization, national defense science and technology industry more weight is given to the students' comprehensive quality and personal qualities, the defense technology has proposed new requirements on talent cultivation in universities. Universities of national defense science and technology should systematically study and deeply grasp the capability and quality requirements of talents, strengthen the top-level design and overall planning of personnel training, and take the cultivation of students' comprehensive qualities such as innovative spirit and practical ability as an important focus, so as to provide continuous internal thrust for the cultivation of national defense science and technology innovative talents.

Second, the military culture should be used to cultivate the professional values of college students. College is the most critical stage for the formation of college students' outlook on world, life, values and historical dialectical thinking, and the orientation of college students' professional values determines their future career direction. For example, "achievement motivation" factor Y3 ranks third in the characteristic value and contribution rate of general competency, which reflects that the particularity of defense technology industry requires students to have corresponding consciousness structure and value orientation. Colleges and universities of national defense science and technology should adhere to moral education, deeply explore the unique ideological and political education characteristics of national defense culture, and integrate the construction of national defense culture into ideological and political education, teaching, practical activities and other professional value cultivation. Strengthen students' value identification for national defense, cultivate students' ideal belief, national spirit and patriotic feelings, guide students to combine their personal interests and personal development with the needs of the motherland, and provide talent support for the construction of national defense.

Third, we should build a new mode of university and enterprise talent training. This study verifies that national strategy, technological innovation, self-development and other aspects of the defense science and technology industry to the talent evaluation of the relevance, diversity, directional requirements. Based on the survey, it can be seen that the current national defense science and technology university students professional practice training is insufficient, discipline and professional development disconnect, talent knowledge system and training system does not match. National defense science and technology universities must have strategic thinking, in the strategic development period of "double first-class" construction, take the initiative to target the social development and further strengthen the cooperation with the national defense science and technology

industry. At the same time, it gives full play to its unique educational resources and advanced research advantages, and gradually builds a new mode of talent training that meets the needs of national major strategies, economic and social development, and talents in the defense science and technology industry.

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