

Practice of Characteristic Major Construction Facing Industry Needs

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1. Background of characteristic major construction

The history of Beijing Jiaotong University (BJTU) can be traced to 1896 when it was the Railway Management Institution established by the Qing Dynasty. It is the first university for training talents of railway management with professional industry background and outstanding advantages. In April 2000, BJTU was incorporated with Beijing High School of Electrical Power and further under the administration of the Ministry of Education from the Ministry of Railways. Now BJTU is one of the first key universities which are built preferentially in the National Project "211".

MS. Chen Zhili pointed out that[1], institutions of higher learning should insist the scientific development view to guide higher learning, take the quality-improvement as the center and strengthen management, to develop major characteristics. In china, characteristic universities are the results of history and at the same time, they are also a precious wealth in the national higher education system at present and in the coming period[2,3]. Characteristic subjects and majors are the base of the

characteristic universities, research and practice of the characteristic major construction are performed combining with the leaping development of the railway industry in this paper.

With advantages of high speed, big capacity, low energy consumption, low pollution, high safety and so on, railway transportation has always been the most important transport means in the world.. And it plays an important role in the development of national economy.

In China, the railroad is always the main artery of the national traffic all the time. Five large-scale speed-up during the ninth five-year plan and the tenth five-year plan used to make the transportation condition better and contribute a lot to the national economy sustained, healthy, stable development and rapid growth. But with the rapid development of the national economy, railway transportation has become the restriction factor of the national economy. To meet the fast increasing national economy, "Medium and Long-term Railways Network Planning" proposed by the Ministry of Railway was approved to implement by State Department. According to the planning, 10,000km passenger-dedicated line will be built, which is 2.3 times of the total length of the whole world high speed railway lines. The railway industry takes the

“Introduction-Absorption-Innovation” strategy as the guideline to realize the ultimate aim of changing “Made-in-China” to “Created-in-China”, “Major Industry Nation” to “Powerful Industry Nation”. With the sixth speed increase, the operation of high-speed EMUs makes our country joining the high-speed railway list of the world.

The high-speed EMUs adopt multiple high technologies in fields of mechanics, materials, electronics, computer science, network communication and engineering simulation, as well as the latest significant achievements in the railway field such as high-speed wheel/rail interaction, high power traction, braking control, train operation control, aerodynamic engineering, reliability and security technology.

While importing the high-speed EMUs, the Ministry of Railways started technology transfer on EMUs between the main civil passenger cars and related components manufacturers and foreign EMUs manufacturers. On one hand, EMUs are in great need for railways, so the civil EMUs manufacturer spend most time and energy on the technical process of the original EMUs; on the other hand, foreign manufacturers refused to transfer some key technology, which makes it hard for civil manufacturers to design high-speed EMUs with Chinese characteristic, independent intellectual property and key technology according to the domestic operation situation. For a urgent demand of talents mastering EMUs technology to overcome these difficulties and realize the aim of the railway industry, institutions of higher learning should take charge of cultivating innovative talents in this field.

The Railway Rolling Stock direction of Mechanical Engineering and Automation Major of BJTU used to be Railway Rolling Stock, internal-

combustion engine specialties etc., of Northern Jiaotong University founded in 1958, which had cultivated nearly 5000 bachelor graduates for railway industry and was integrated to Mechanical Engineering and Automation according to the major list made by Ministry of Education in 1997. As one of the key universities under the administration of Ministry of Railways before, keeping the school motto of “Knowing and Doing” in mind and dedicating themselves to the service of the country, professional teachers in this major always take cultivating talents for railway industry as their own duty. With support of the university, they have been building the railway characteristic major and taking research and practice on major construction mechanism, teaching team structure, exemplary achievements.

2. Long-term major construction interactive mechanism between universities and enterprises

From 1993 to 2004, management system of colleges and universities in China was readjusted under the guidance of “teamwork, adjustment, cooperation, combination”. BJTU was closely linked to China’s railway industry when it was established about a hundred years ago. During the past many years’ development, advantage of major has been highlighted and the pattern of running a school closely integrated with industry needs is founded. Facing the new situation, the government advocates characteristic university construction, which is significant to realize classified guidance and characteristic development of the national higher education.

1) Joining in the industry innovation, mastering knowledge structure of talents

The first problem that Characteristic major construction should solve is how to cultivate talents needed by the industry. Vehicle engineering subject relied by this major enrolled graduates for the first time in 1963 and got authorized by the central government to confer master degree in 1981, doctor degree in 1990. Approved be to a focused major by the Ministry of Railways in 1994, now it's a national focused major and engineering center of the Ministry of Education. With advantages of major, professional teachers take active part to carry out "Introduction-Absorption-Renovation" projects from Ministry of Railways and national high-speed railway projects. They have gained lots of achievements on high-speed railway theory and new technology, which lays the first stone for cultivating high-level and innovative talents.

Moreover, we actively take part in the training work of Ministry of Railways, and has founded theory education base for operators of high-speed EMUs. Through staff cultivation and science research cooperation between universities and enterprises, we know that the technology such as train network control, integrated design of high-speed EMUs, etc. are required for designers and operators, which also provide the basis for the curriculum optimization and making relevant practice link.

With accumulation of basic theory and knowledge structure requirements for talents, long-term interaction mechanism between universities and enterprises was established in the major to ensure the talents cultivation scheme to be made by the universities together with the enterprises. As a result, while paying attention to multi-disciplinary

integration, course characteristics such as wheel/rail interaction and relation between pantograph and contact wire are emphasized.

Design and manufacture of electromechanical product, as well as safe and high efficient operation and management of trains are contained. Furthermore, course connection of mechanical engineering, electrical engineering, electronic information engineering and project management etc. could be arranged reasonably.

2) Building long-term interaction mechanism between universities and enterprises

As high-speed EMU technology is the key factor in increasing the railway operation speed, mastering the technology indicates that the civil level of passenger transport equipment has caught up with the advanced world level. Major construction in the universities must be positioned on talents cultivation required by the enterprise which is the center of technology innovation. Based on the field survey home and abroad, relationship between this specialty and enterprises has been established by taking part in the "Introduction-Absorption-Renovation" projects of high-speed EMUs and cultivating designers and operators of the EMUs authorized by Ministry of Railways.

On this basis, the cultivation system and content of traditional railway rolling stock were rearranged after communication with the enterprises. Integration and regeneration to the specialized basic course and specialized course were performed, and course system and content on EMUs were also rearranged by combining design and manufacture, machinery and electricity, computer simulation and experiment to develop characteristics and cultivate talents on high-speed EMUs in great need. By introducing

the enterprises' relevant subject into graduation project and main course design, long-term interaction mechanism between universities and enterprises was set up.

Students in this major will be cultivated in the diversified talent-training mode since the junior year. Funds and conditions come from enterprises, and students will take some fundamental and pre-research work as their course design, graduation project or social practice, such as translation of design and manufacture standards and specifications of foreign high-speed EMUs, comparison and selection of dimensions and materials of the components, verification of the parameters supported by foreign institutions with various simulation software, design of small parts, database design on fault information of the key parts, etc. This training mode supplies the enterprises with technology support, and provides students with application of knowledge. Based on those practice, long-term interaction mechanism between universities and enterprises closely combining with industry development was built, which plays demonstration role for relevant specialty construction and innovation in some characteristic universities with industry background.

3. The integral team construction of teaching and scientific research

Teachers in universities are the knowledge source of scientific innovation, but many professors are taking much time to do research while little to undergraduate education; the young teachers also pay more attention to research and papers for promotion. This conflict got solved through the

integral team construction of teaching and scientific research.

Firstly, related policies were made and posts of characteristic major construction were set. In teaching aspect, professors with high teaching level and deep scientific attainments are motivated to join our teaching team, and there are 2/3 professors of the school are engaged as teachers in this specialty; in scientific research aspect, due to its demand for scientific research and talents cultivating, we got the fund of 23 million RMB to construct the load calibration system on the bogie of high-speed EMUs under random loading, Which has the international leading level. Meanwhile, advanced research platform and stable research direction were determined.

Secondly, to cultivate young teachers with technology of high-speed railway, they were required to take part in the international communication, enter enterprises, train workers on EMUs, and take charge of the "Introduction-Absorption-Renovation" projects from Ministry of Railways, so that they would understand if theory is not contacted with practice, they couldn't gain achievements in scientific research and teaching.

Lastly, a series of measures are implemented such as establishment of course system duty, optimization of teacher allocation among the whole specialty, construction of course teaching team composed of professors, associate professors and core teachers, emphasizing on teaching research, improvement of the case teaching level and content, review and guidance case teaching advancement feature, creating conditions for main course teachers to become famous teachers, etc. At the same time, excellent enterprise and research institution experts are invited to be part-time

professors and it has formed to be a mechanism.

By aforementioned work, a team with high-academy and reasonable structure, combining teaching with scientific research, was founded, which focus on the latest theory and technology on high-speed EMUs. This team was awarded by the honorary title “excellent teaching team of Beijing”. Evaluations from experts are as follows: Respect and love their own post and initiate knowledge and educate students; master the advanced technology on EMUs, closely cooperate with enterprises and research institutions, realize combination of the backbone teachers and key researchers, cultivate excellent teachers for undergraduate education, improve the whole teaching and researching level of the characteristic team.

4. Achievement of the characteristic major construction

Construction of characteristic major shouldn't only satisfy the industry needs. More importantly, it should offer the thought and lessons as representative achievements to the similar characteristic universities with industry background.

1) Characteristic teaching materials

Cultivation of talents and propagation of knowledge not only call for high level teaching team but also construction of teaching materials. With constant renewal of modern technology and knowledge, it's especially urgent to compile teaching materials integrating new technology into common basic theory.

By sorting and summarizing systematically the material of high-speed EMUs, undertaking the

“Introduction-Absorption-Renovation” projects, teachers in this major deeply understand and master the EMU technology, which pushed construction of the technology platform for research on high-speed EMUs. Based on writing the three versions of cultivation materials and taking research projects on EMUs, teachers of this major compiled the first series of teaching materials with high-speed EMUs characteristic, integration new technology into common basic theory, which contain the newest design, manufacture theory and technology of the high-speed EMUs. For widely being used in similar major, it solved the conflict that teaching material content can not keep synchronization with the constant renewal and rapid development of the enterprise technology. Therefore, students can master the advanced design ideas, methods and standards, which ensures quality of the talents on high-speed EMUs, and provide an example for other majors to write teaching materials.

2) Characteristic practice teaching link

To help students to combine knowledge with ability, innovation of practice teaching system is emphasized and various practice modes are set up, which can foster students' interest and generate thirst for knowledge and enable them to participate. In other words, by reasonably arranging experiment teaching, practice, course design, military training and social investigation, extracurricular authentication and competition, graduate project, scientific research, innovation plan, and so on, the cultivation plan with gradual implementation during the four years was made, which takes engineering diathesis cultivation, basic practical ability, comprehensive design ability, scientific research accomplishment, creative

ability as target and shows characteristics as “multi-level, multi-modes, in-class teaching combined with out-class activities, required courses combined with selective courses”.

Relying on Mechanical Engineering Teaching Demonstration Center of Beijing, experiment system of simulating kinds of EMU equipments based on network control was developed and the unique EMU characteristic laboratory in china was built. These independent development devices can be used for independent experiments, cross-curricular comprehensive experiments based on train network and creative experimental projects of college students. Besides, scientific achievements and equipments in the National Structure Strength Metrology Accreditation Lab and Engineering Research Center of Structure Reliability and Operation Measurement Technology of Rail Guided Vehicles, Ministry of Education are all opened to undergraduates, which can improve the experimental teaching level.

Practice base outside school was established through cooperation with enterprises. For their first year, students will visit Railway Museum and railway filed to know about the new railway technology; during the following two years, students will be organized to practice in the practice base outside school once a year; and course design and graduate project will be arranged to enterprises in the last year. The total time spent on practice in enterprises is longer than 8 months.

3) Cultivation model of characteristic major

Talents cultivation modes in higher-education institution show various characteristics and have some basic patterns such as “3+1”, “2+2”, “2+1+1”. To improve the talents training quality,

meet with the industry needs, expend employment channels, and embody the school-running concept, the “3+1” talents training mode was established by cooperating with high-speed EMU enterprises those would provide “human resource, material resource and financial resource” to accelerate talent introduction, shorten the period of talent cultivation, improve the efficiency of talent cultivation and employment.

Commissioned by Personal Department of Ministry of Railways, EMUs specialty was set up in BJTU based on the CEEUSRO firstly. Through the cultivation of three years’ mechanical courses and one year’s EMU specialty, featured of “solid foundation, distinct characteristic”, it’s realized that specialized talents of high-level on EMU sign contacts with enterprises in their junior year. Until now, three batches of graduates have been cultivated in “3+1” mode, which has been used in the cultivation of EMU drivers with bachelor degree by Southwest Jiaotong University.

4) characteristic professional websites

Excellent course websites of Beijing city level such as Theory of Machines and Mechanism, Design of Machinery, were set up, as well as university level excellent courses websites such as Automatic Control Theory, Microcomputer Principles and Interface Technology, EMU equipments, EMU design, etc. The websites contain introduction to the courses, teaching syllabus, experimental syllabus, introduction to the main teachers, teaching schedule, teaching video, electronic courseware, exercises, etc. which realized distance education and promote self-regulated learning. Dozens of papers on teaching reform were published to communicate with other

engineering profession. Introduction to railway rolling stock in April 2008 got the highest monthly audience rate of CETV1.

5) Conclusions

Seizing the opportunity of the leaping development of railway industry and the urgent needs for talents in the construction of passenger dedicated line and Beijing-Shanghai high-speed railway, teachers in this specialty led to undertake "Introduction-Absorption-Renovation" projects on EMUS. In addition, teachers were sent to foreign high-speed EMU enterprises to join localization of the imported projects, And more than 1600 EMU workers were trained in the base of theory education. All the above work provided talent support for the sixth speed increase.

Through the work above, based on mastering the knowledge structure of talents urgently needed for EMUs, long-term interaction mechanism closely connected with industry needs was set up. By combining design and manufacture, machinery and electricity, computer simulation and experiment, theoretical system and teaching system were established; an excellent teaching

team combining teaching with scientific research, being good at EMU technology, was founded, and they compiled the first series of high-speed EMU teaching materials in china; due to its demand for scientific research and talents, recurrent system of railway industry was founded benefited from which advanced research platform and stable research direction were determined; to cultivate creative talents, experiment system of simulating kinds of EMU equipments based on network control was developed and the unique EMU characteristic laboratory in china was built; experiences and achievements of major construction have been disseminated to the whole country in many ways. ♪

♣ References

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