

# *Research on the Talents Training Mode of the Automotive Electronics Technical Major*

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**Abstract**—For the development of automotive electronics industry demand and the improvement of the competitiveness for talents, one talent training pattern was constructed including improving the level of the teachers and school-enterprise cooperation mechanisms besides the reforms of curriculum system. It was proven to be feasible that the quality of the talents can be improved by such aspects as encouraging initiatives of the teachers, revolution of the practice teaching, enhancing the practical ability of the students.

**Keywords**—*automotive electronics; teacher quality; school-enterprise cooperation; curriculum system; talents training pattern*

## I. INTRODUCTION

In recent years, the biggest automotive market has come to China. The automotive industry has become one of the economic pillar industries in China. It was known that the problem of environmental pollution and the energy crisis has already been serious when our lifestyle has changed and improved by the traditional automotive industry<sup>[1-2]</sup>. A range of policy has been implemented to promote the development of the automotive industry and keep the energy system security besides upgrade of the living environment in China<sup>[3-6]</sup>. The Chinese automotive industry has been entered a new period of the rise of the new energy vehicle, intelligent and internet vehicle. The development of the automotive electrical industry has significant influence on the competitiveness of the automotive industry which leads to much higher demand for the practitioner Electronics Major

This paper was focused on the teaching reform of the automotive electronics curriculum system to meet the new demand in three ways which includes teacher quality, school-enterprise cooperation and curriculum system based on the experience of the excellent automotive electronics class which is one of the reform projects of the Tianjin University of Technology and Education.

## II. ANALYSIS OF THE AUTOMOTIVE ELECTRONICS PROFESSION

### A. *Status Quo of Employment*

The automotive Electronics Major was not separately established in most relevant colleges in China except few specific ones. It was found that this major was the crosses of other relevant majors such as power electronics, automation technology, internal combustion of engine and automotive engineering. It was reported that the automotive electrical employee will be still on that short supply for the foreseeable future in China<sup>[7]</sup>. It was shown that amounts of new jobs were created since the fast development of the intelligent, internet and new energy vehicle industry.

TABLE I. STATUS BETWEEN SUPPLY AND DEMAND

Relevant Major	Status
Automotive Maintenance & Detection	balanced
automobile application technology	balanced
automobile network communication	demand over supply
electronic components research	demand over supply
automobile spare parts supply chain	demand over supply
Internet of Vehicles	demand over supply
Entertainment navigation technology	demand over supply
Electrical control technology for new energy vehicle	demand over supply

### B. *Location of the Automotive Electronics Major*

There is little competitive product designed by the Chinese company in the automotive electronics field such as engine control, vehicle network communication and electronic chassis control since the foreign company monopoly. More and more key technology fields of the automotive electronics were opened to the Chinese talents as much more found was pumped into the relevant field sponsored by the government and company when the automobile was electrified and changing to be intelligent. Some typical jobs of the automotive electronics were listed in Table II.

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This work is supported by the TUTE teaching reform project(A practical study on the improvement of students' normal skills in Automobile Specialty).

TABLE II. JOB DESCRIPTION AND ABILITY REQUEST

Number	Job description	Ability request
1	Vehicle electrical design	Development and inspection of the automotive electronic equipment; Diagnosis system of the vehicle electrical system; vehicle electronics and control; engine electronic control system; Integrated Circuit Design; embedded systems programming; Application of the control strategy tools; Test of the automotive electronics; vehicle EMC test and analysis; Selection of the semiconductor and electrical component; image recognition; signal processing technology; new energy vehicle control system; motor control system; Battery management; engine automation measurement and diagnosis; Chassis system fault diagnosis and maintenance; controlling vehicle body; vehicle network diagnosis...
2	Vehicle communication network	
3	Design and matching of the chassis electrical system	
4	Transmission electron development and tuning	
5	Engine electrical control system	
6	Engine and vehicle calibration	
7	New energy vehicle control system	
8	Development and matching of the car electrical safety systems	
9	Automotive infotainment electronics system	
10	Vehicle EMC test	
11	Vehicle internet device	
12	Vehicle data process	
13	Technical consultant for vehicle marketing	
14	Vehicle maintenance and repair	
15	Vehicle inspection station	
16	Auto parts logistics and warehousing system	
...	...	

III. TALENT-DEVELOPMENT OF THE AUTOMOTIVE ELECTRONICS MAJOR

A. Architecture of the training system

The traditional training mode and course teaching reform could not follow the revolution of the automotive industry especially the rise of the development of the automotive electrification, intelligentalize and informatization. It is a huge challenge for the training system of the automotive Electronics Major to meet the changing demand of the industry. The architecture of the training system was illustrated in Fig.1 that the quality of personnel training can be upgraded based on construction of the teacher team and school-enterprise cooperation besides revolution of the curriculum system.

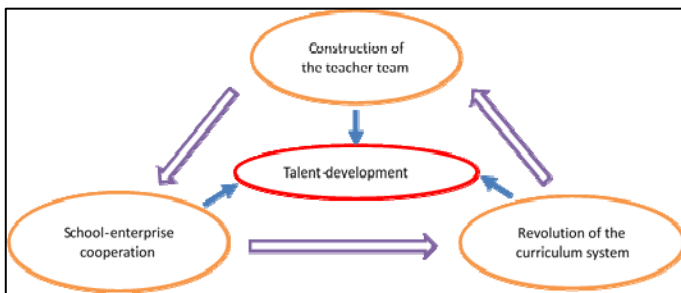


Fig. 1 Architecture of the training system

B. Construction of the teacher team

It is helpful to improve the quality of personnel training when the teacher team was constructed with such teachers who have good professional knowledge, professional ability, and

broader vision of the industry. It is effective in quality of personnel training when the teacher was encouraged and supported to enhance their research capability with the enterprise cooperation. The more enterprise cooperation the teacher was involved, the higher approval of the school the enterprise has and the more valuable industry information can be brought into the class, the better quality of personnel training. So some long-term promotion mechanism of teacher ability should be established such as training sponsor, on-job doctorate and postdoctoral to improve the level of the teachers continuously.

The graduates have been well received by the employer from the experience of the excellent automotive electronics class which is one of the reform projects of the Tianjin University of Technology and Education. One of the most important reasons is the excellent teaching staff. It can be found that there are some typical characteristics of the team such as the appropriate age, high academic degrees, rich work or research experience which are useful to the students in Table III.

TABLE III. CONSTRUCTION OF THE TEACHER TEAM

characteristics	Specifications
Average age	38 years old
Ratio of the one with doctor degree	82%
Ratio of the one with work or research experience	95%
Ratio of the one with enterprise projects	90%

C. School-enterprise cooperation

The gap was closed between the student capability and the requirement of the employer when highly efficient school-enterprise cooperation was operated. It is helpful to improve the cooperation will of the enterprise if the teachers were allowed and supported to participate in their production activity in the process of teacher team construction. There are some ways to recommended to the cooperation including good understanding of the production activity characteristics and their need.

1) Co-building the training base

In this mode, the equipment of the training base was offered by the enterprise and the school was in charge of the fields. Teaching material contents and training methods were from the practice production process. The cost of the equipment and fund pumped by the enterprise can be compensated by the production from the training process. On the other hand, the students participated in the practice production which is helpful to their handling ability. Some potential employees could be located at an earlier stage meaning less risk of recruitment.

2) Customized training plan

The enterprise was deeply involved in the teaching process in order to realize effective training result. The training program and teaching process were based on the ability requirement of the enterprise. The combination of education

with productive labor is one of its notable characteristics and the vocational adjustment period was reduced.

### 3) Training service for the enterprise

The new staff training and development were organized in school training base fully using the fields, equipment and human resource. In this way, the cost of employee training was significantly reduced and it is helpful to both teacher and student to understand what is really needed for the enterprise.

Employee training can be applied in the school training base ahead of the graduation based on the effective school-enterprise cooperation. For example, extensive school-enterprise cooperation was realized to enhance the competitiveness of the excellent automotive electronics class. The major achievements were listed in Table IV.

TABLE IV. LIST OF SCHOOL-ENTERPRISE COOPERATION

Name	Cooperation way
China Automotive Technology and Research Center	Research Center; Practice training base
Tianjin Qingyuan Electric Vehicle Co.,LTD	Research Center; Practice training base
Tianjin Santroll Electric Vehicle Technology Co.,Ltd	Training service base
Tianjin ECAR Technology Co., Ltd.	Research Center; Practice training base
Tianjin bool Technology Co., Ltd.	Research Center; Practice training base
Tianjin Macro Automobile Co., Ltd	Practice training base; Training service base
Tianjin Shengwei Technology Co. Ltd	Research Center
China FAW Group Corporation R&D Center	Research Center; Practice training base

### D. Revolution of the curriculum system

It is hard to follow the fast changing steps of the automotive electrical industry since the slow rhythm of the revolution of the curriculum system. It was verified that the curriculum system can be improved from three directions.

#### 1) Knowledge update

It is essential to the curriculum system that the relevant courses for the new energy vehicle should be implemented into the class including motor control technology, battery management and vehicle control information. On the other hand, courses related to vehicle to internet and advanced driver assistance system should be implemented gradually.

#### 2) Practice and Competition

The practice training program should be designed under suitable consideration of the combination with both inside class teaching and outside class teaching, school practice training and working practice. Kinds of helpful conditions should be provided to support various innovative competitions and graduation projects processed in enterprise aiming to arouse students' enthusiasm in practice.

#### 3) Teacher encouraging

Undergraduate tutor system should be undertaken as early as possible to help the student changing knowledge to practice ability. Revolution of the teacher performance evaluation system is necessary. Because only the teacher is supported to

attend the enterprise production process, the students would have the opportunity to be involved in participating in real production activity.

Some experience was gained through long-term exploration and practice of the excellent automotive electronics class and in return, the graduates were welcome to the industry since their superior adaptation. Typical reform of the curriculum system was listed in Table V.

TABLE V. REFORM OF THE CURRICULUM SYSTEM

Items	Parameters
New course	"New Energy Automotive Technology"; "Automotive Embedded System"; "Embedded Automobile Network System"
Technological competition	the National Undergraduate Electronic Design Contest; Honda Energy Conservation Competition of China; Formula Student China
Proportion of students joint in research	24%
Proportion of graduation projects process in enterprise	73%

### IV. CONCLUSION

It is a great new challenge to the talents training mode of the automotive electronics technical major when more and more complex talents are needed to meet the growing demand who should be good at automotive technology, automation and electrical control. Architecture of the training system for the automotive electronic technical major was proposed based on construction of the teacher team, school-enterprise cooperation and revolution of the curriculum system. It was proved to be effective in the quality of the graduates that the popular talents should be trained under such system which can follow the trend of the industry, inspire the teacher and lift the practice ability of the students.

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