

# Exploration and Practice of Laboratory Construction for the Major of Urban Rail Transportation

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**Abstract**—With the rapid development of domestic urban rail transit and the increasing demand for the talents in this field, a new specialty of urban rail transportation is established in many colleges and universities in order to adapt to the social development. In view of the construction on the laboratory for the new specialty of urban rail transportation, this paper summarizes the characteristics of the equipment in such laboratory and the main problems in the laboratory construction. Combined with the actual construction case and experience, the idea for the laboratory construction is put forward and the important role of the planning for the laboratory construction is clearly determined.

**Keywords**—major of urban rail transportation; laboratory; construction planning; construction practice

## I. INTRODUCTION

In the past two decades, China has experienced an unprecedented peak period of urban rail transit construction. It

is expected that the construction of urban rail transit will continue to develop at a high speed in the next 10-20 years. The rapid development of domestic urban rail transit industry has led to a substantial increase in the demand for urban rail transit talents. Therefore, in recent years, many domestic colleges and universities have strengthened the specialty direction construction of urban rail transportation, added urban rail transportation specialty or set up urban rail transportation colleges. The basic statistics of all kinds of education (related to specialty) at all levels in 2017 are shown in Table I, and the statistics of Higher Vocational (specialized) colleges offering rail transportation specialty are shown in Table II.

For the Railway Transportation and Urban Rail Transportation, the two majors with the largest number of specialty schools are High Speed Railway Passenger Crew (600113) and Operation Management of Urban Rail Transportation (600606). The regional distributions of these two majors in China are shown in the Fig. 1 and Fig. 2.

TABLE I. STATISTICS OF BASIC SITUATION OF ALL KINDS OF EDUCATION AT ALL LEVELS(RELATED TO SPECIALTY) IN 2017

Educational Level	Educational Type			Scale (School' Number)	Enrollment (thousand)	Students' Number (thousand)
Secondary Education	Secondary Vocational Education	Senior High School	Common Technical Secondary School	3346	2462.485	7129.894
			Adult Secondary Education	1218	568.771	1272.446
			Vocational Senior School	3617	1483.979	4140.553
			Technical Senior School	2490	1309.068	3382.075
		Junior Middle School	Technical Junior Middle School	15	0.0956	2.738
	Non-governmental Education			2069	786.8	1973.3
Higher Education	College and University		Undergraduate University	1243	4107.534	16486.320
			Higher Vocational Colleges	1388	3507.359	11049.549
	Civilian-run Colleges and Universities			747	1753.7	122.5

<sup>a</sup> Table footnote: The above table is obtained after data reduction from China Education Statistics Network.. The statistics for 2018 are not completed yet.

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TABLE II. STATISTICS OF HIGHER VOCATIONAL(SPECIALIZED)COLLEGES WITH RAIL TRANSPORTATION SPECIALTY IN 2018

Rail Transportation Correlation Specialty				Scale (School' Number)	The Total
Specialty Type		Specialty Code	Specialty Name		
60 Science of Traffic & Transportation	6001 Railway Transportation	600101	Railway Locomotives	40	566
		600102	Railway Vehicles	30	
		600103	Railway Power Supply Technology	52	
		600104	Railway Engineering Technology	55	
		600105	Railway Mechanization Maintenance Technology	10	
		600106	Automatic Control of Railway Signaling	42	
		600107	Railway Communication and Information Technology	27	
		600108	Management of Railway Traffic Operation	47	
		600109	Railway Logistics Management	19	
		600110	Railway Bridge and Tunnel Technology	9	
		600111	High Speed Railway Engineering Technology	36	
		600112	High Speed Railway Passenger Crew	168	
		600113	Maintenance Technology of Electric Multiple Units	31	
	6006 Urban Rail Transportation	600601	Urban Rail Vehicles Technology	58	485
		600602	Urban Rail Transportation Mechanical and Electrical Technology	82	
		600603	Urban Rail Transportation Communication and Signaling Technology	46	
		600604	Urban Rail Traffic Power Supply and Distribution Technology	21	
		600605	Urban Rail Transportation Engineering Technology	80	
		600606	Operation Management of Urban Rail Transportation	198	

b. Table footnote: The data is from the website of Sunshine College Entrance Examination, the designated platform of Sunshine Project for College Enrollment of the Ministry of Education. Data statistics deadline: Dec. 30, 2017, obtained by analyzing the university enrollment specialty statistics in 2018 one by one.

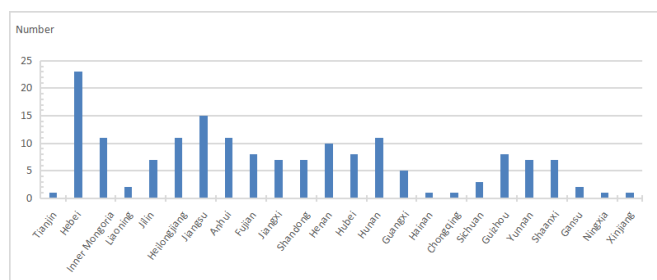


Fig. 1. Regional Distribution of the major of High Speed Railway Passenger Crew in China

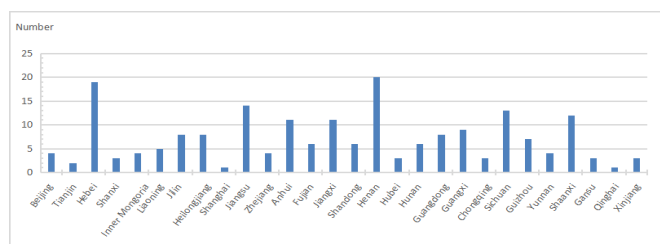


Fig. 2. Regional distribution of the major of Operation Management of Urban Rail Transportation in China

Regardless of whether secondary education or higher education, it is predictable that the talents cultivation objective in the future need to be adjusted to the cultivation of students' application ability, and the practical ability training should be strengthened. Based on experimental teaching, it is possible to increase the practical transformation from theoretical knowledge to ability, the experimental and practical teaching should also strengthen the students' practical ability, improve students' ability to face application, face problems and make comprehensive use of the knowledge they have learned, stimulate students' innovative thinking, and promote the

coordinated development of knowledge, ability and quality [2,5-6].

At present, the country is speeding up the development of modern vocational education, and some ordinary undergraduate colleges and universities in various provinces and cities are also transforming into application-oriented colleges and universities. This puts forward higher requirements for students' practical skills in traditional undergraduate colleges and universities, which is the actual demand of society for talents and the inevitable result of times development.

Whether for the industry background or the times background, practical skills are required to become a key part of the ability for the students of urban rail transportation, which requires full consideration in the laboratory construction and development planning. It is a good opportunity for the construction of new professional laboratories of urban rail transportation.

## II. CHARACTERISTICS OF LABORATORY EQUIPMENT FOR URBAN RAIL TRANSPORTATION

Because of the particularity of urban rail transit industry, the laboratory equipment for the major of urban rail transportation have the following characteristics.

1) Near-field and high-level simulation. In the talent cultivation process of urban rail transportation at all levels, for the combination with practice, laboratory equipment is needed to be as close to the enterprise production field as possible and the higher the simulation degree, the better. At the same time, in order to cultivate students' professional attainment and meet the teaching requirements for the station related equipment, the overall decoration style of the laboratory is also need to close to the enterprise production field.

2) Large equipment and wide area. Urban rail transportation equipment, from vehicle to control system, are

huge and occupy a large area, which requires enough space and space be reserved in the laboratory planning.

3) High cost and large investment. Because of the particularity of the industry, the cost of real equipment is high. Because of the scale economy of production, the short development time of the teaching equipment industry of urban rail transit and the barriers to entry for enterprises, there is no full competition. Therefore, if the laboratory wants to form integrity and seriousness, the equipment investment will be large.

4) High precision and good environment. Urban rail transit system is complex, and the equipment embody integration, intelligent, networking and automation. It requires high precision and strict environment of equipment. Therefore, the environmental construction of laboratories should be planned.

### III. MAIN PROBLEMS IN THE CONSTRUCTION OF NEW URBAN RAIL TRANSPORTATION SPECIALIZED LABORATORY

1) Blind construction. Laboratory construction lacks of overall planning, such as confused layout of laboratory equipment, undefined functional orientation and unclear construction goal. For the large investment in experimental equipment of urban rail transportation, it needs installment construction and carrying out by stages while maintaining the relative independence and integrity of each stage. This requires that the construction of laboratories should be planned ahead; otherwise the construction investment will be blind, lacking succession and leading to repetitive construction [1].

2) Low utilization rate. The allocation of laboratory hardware resources is not in harmony with the actual needs of teaching. The experimental equipment that really combines with the training program has not been purchased, and the purchased equipment has not been well developed, that lead to the low utilization rate of equipment, the large amount of maintenance and the increase of equipment maintenance costs.

3) Un-prominent highlights. Laboratory construction should embody innovation, highlight characteristics and "bright spots" [3], truly achieve "I have things while others don't; when they processed, mine are better; even if they got the best, mine are unique. ", and do not follow the old-fashioned repetition of others or their own, resulting in a low level of laboratory construction.

### IV. CONSTRUCTION THINKING OF URBAN RAIL TRANSPORTATION SPECIALIZED LABORATORY

By an intensive analysis of urban rail transportation majors in some secondary and higher vocational colleges and undergraduate colleges, it is found that the sequence of specialty construction of urban rail transportation in most colleges is from "soft" to "hard" [8]. First, they construct major of operation management, and then they construct vehicle engineering and communication & signaling. On the one hand it is not difficult to construct, on the other hand the demand of students is big. The construction planning thinking of the new urban rail transportation specialized laboratory is shown in Fig.3.

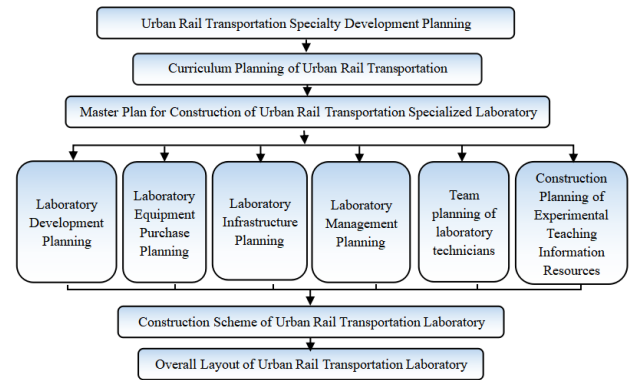


Fig. 3. Planning thinking of urban rail transportation specialized laboratory

According to the characteristics of urban rail transportation specialty, it can be predicted that the future development direction of experimental equipment related to urban rail transportation is electronic, integration and localization. The laboratory can completely reproduce the enterprise production field and restore the real working status of each post. Therefore, the laboratory should be "zero distance" from the rail transit site, and the equipment should be as close as possible to the real equipment. Students can operate the real equipment in schools to improve their practical ability and job docking ability. According to the orientation and characteristics of their own, colleges and universities should establish students-centered experimental and practical training mode in order to realize self-training and hands-on training, fully mobilize students' initiative and enthusiasm in learning, make full use of modern information technology such as network and multimedia to make rational use of multimedia courseware [4], and use experimental techniques such as virtual and simulation to simulate the whole scene in the production field. In order to improve the efficiency of laboratory utilization, we should give full play to the effect of "experiential-integrated" experimental teaching in which real equipment and simulation equipment cooperate and coordinate with each other.

In the process of laboratory construction, we should consider the establishment of urban rail transportation training center. The whole training center can adopt semi-open layout, which is help the overall planning and phased implementation. It consists of two regions: the training base for rail vehicles and the training base for operation and management (Table. III). Fig. 4 shows the layout of the construction case of the urban rail transportation training center.

The construction of transportation training center can adopt task-driven and project-guided teaching mode, and truly realize the students-centered experimental training mode, taking training center as the classroom, and ability training project as the guidance. The planning of the training center mainly considers "teaching, training and examination" as the main line and "career guidance and ability progressive" as the basic idea. The training center is constructed according to the real working environment, real equipment and real operation process. The training center mainly covers two majors of urban rail vehicle and operation & management. It can be executed in coordination and independently. For practice-oriented talented-

worker cultivation colleges and universities, the training system mainly provides job training for urban rail transit system, which can set up job training objects, such as control center dispatchers, system maintenance workers, mechanical and electrical equipment maintenance workers, etc. It can also set up training projects according to specialties, which mainly include transportation and operation management, computer, signaling, measurement and control, automation, etc. At the same time, the establishment of multi-type vocational skills appraisal center to meet the needs of post operation training of metro operation companies.

TABLE III. URBAN RAIL TRANSPORTATION TRAINING CENTER CONSTRUCTION PLANNING

Urban Rail Transportation Training Center	
Rail Vehicle Training Zone	Operational Management Training Zone
Train comprehensive training area Model area of vehicle structure Vehicle structure disassembly and assembly training area Vehicle maintenance training area Multimedia simulation training area	Operation simulation training area OCC Training area Operational management technology training area Station simulation training area Station equipment maintenance training area
Signaling Equipment Training area Driving simulation training area	

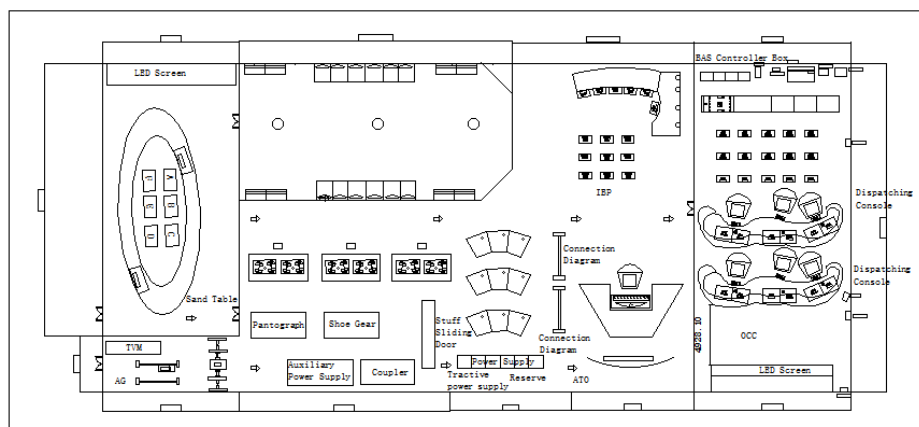


Fig. 4. Regional distribution of the major of Operation Management of Urban Rail Transportation in China

## V. CONCLUSION

Aiming at the laboratory construction of newly added urban rail transportation specialty, by the analysis of the characteristics of the laboratory equipment and the main problems encountered in the construction process, it is found that to ensure the benign development of the laboratory construction, planning is the source, the important support point of the laboratory construction, as well as the premise and key of the laboratory construction.

Laboratory is the practice base in school [7]. Building a good laboratory is one of the necessary basic conditions for operating the college, especially application-oriented higher institutions. Laboratory construction and development planning is a systematic, scientific and innovative work, especially for newly-built majors. It should foresee the development direction, scale and layout of disciplines and majors, and make overall arrangements for laboratory infrastructure, equipment acquisition and staffing. Urban Rail Transportation (URT), as a type of majors developed and added in universities in recent years, its laboratory construction planning is particularly critical and important for the particularity of its industry and equipment.

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