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Analysis of Technical Job Requirements for Intelligent Connected Vehicles from the Perspective of Generative Artificial Intelligence

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Abstract: *During the construction of the intelligent connected vehicle technology program in higher vocational education, the project team established talent cultivation goals and job positions. They defined work projects and tasks for these positions, conducted a job competency analysis, aiming to provide references for implementing reforms in professional talent cultivation models and restructuring of professional course systems. The textual data mainly comes from recent surveys of multiple automotive-related enterprises, focusing on the requirements that companies have for employees in the intelligent connected vehicle technology program at higher vocational colleges in terms of knowledge, skills, and qualities. The survey records include the company's own situation, the distribution of human resources across different positions, the demand for knowledge, skills, and qualities, their importance and shortage, the satisfaction evaluations of graduates from this program by companies in various positions, the positions targeted by this program, and the knowledge, skills, and quality requirements for these positions. It also includes suggestions from companies for the future development of this program. The survey on job competency requirements was conducted to form a job competency analysis table, which sets up professional courses based on principles of professionalism, practicality, and advancement. It is recommended to optimize the course structure and adopt an integrated theoretical-practical teaching model to ensure the quality of talent cultivation.*

Keywords: *Job Demand, Key Technology, Quality Requirements, Satisfaction Evaluation, Human Resources, Technical Expertise*

1. Introduction and Data overview

The text data originates from a questionnaire survey conducted in 2024 among multiple automotive-related companies. The survey primarily focuses on the requirements that enterprises have for professionals in the intelligent connected vehicle technology program at vocational colleges, covering various aspects such as knowledge, skills, and qualities. It includes information on the companies 'own situations, the distribution of human resources across different positions, the demand for knowledge, skills, and qualities, their importance and shortage, the satisfaction levels of different positions regarding graduates from this program, the positions targeted by this program, the knowledge and skill requirements for these positions, and the companies' suggestions for the future development of this program[1]. The data consists of 25 rows, representing 25 surveyed companies, with each row containing over 6,500 columns across 82 major items.

The categories, operating times, and employee sizes of the 25 companies are shown in Figure 1. In Figure 1, the three-dimensional bar chart has a horizontal axis representing company types, a vertical axis representing the operating time of the companies, which refers to the years from their founding date to the survey date, and a height axis representing the number of employees. Each category's bar is formed by the cumulative number of employees across multiple companies within that category. Each color represents one of these companies, with the height of the bar indicating the number of employees in that category[2]. The two numbers above each bar represent the number of companies and the total number of employees in that category, such as private enterprises and companies with an operating time of 20-30 years, totaling 2 companies with a combined employee size of 6,281 people.

For analysis content and purpose, through the organization and analysis of data, it was found that the main contents involved in the questionnaire survey include: job requirements, knowledge/ability/skill

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requirements, certification of certificates and skills, talent cultivation evaluation, industry trends and technical requirements, suggestions for school-enterprise cooperation, job work standards and procedures, etc.[3] Considering the professional development and curriculum design of vocational colleges, the primary content of this analysis is selected to be the job requirements of enterprises and their corresponding knowledge/ability/skill requirements. It is hoped that these analyses will provide references for the talent cultivation of vocational colleges and the reform of vocational education[4].

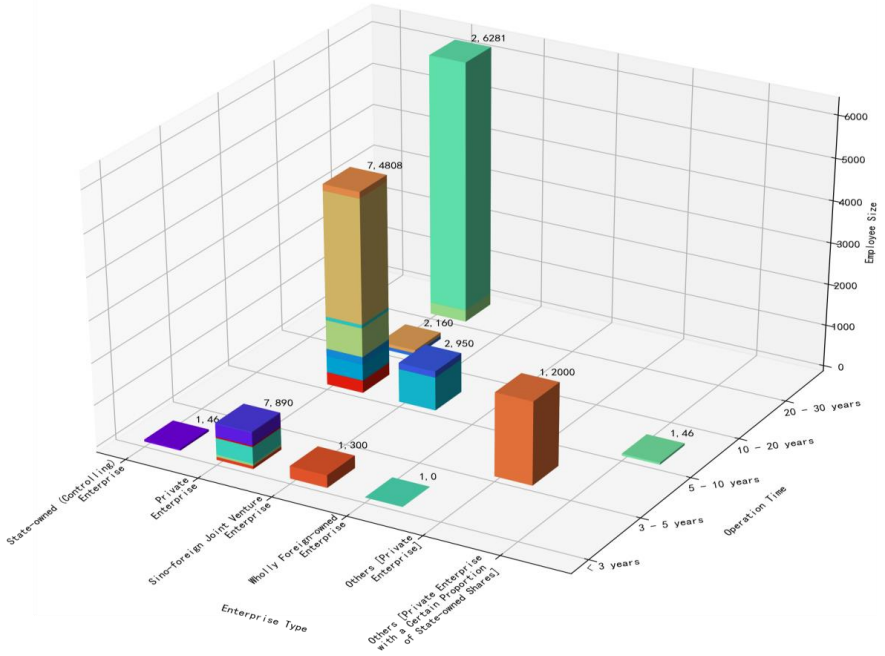

Figure 1 Cumulative bar chart of the number of employees in different types and operating hours

2. Specific analysis of content and results

2.1 Job Demand Analysis

2.1.1 Typical job distribution

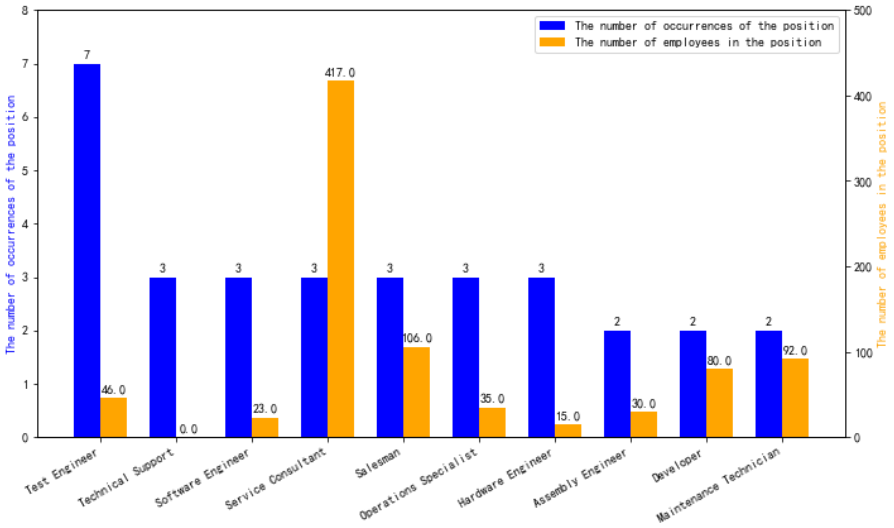

Figure 2 Bar chart of the top 10 positions by frequency and number of employees

Through the distribution of typical positions and the number of employees in each position among current employees of various enterprises listed in the questionnaire, we obtained the frequency of each position across multiple companies and the total number of personnel in these positions, providing a reference for analyzing job requirements. After analysis, graduates from associate degree programs in

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automotive electronics technology were distributed across 88 positions in 25 companies. Ranking them based on their frequency across multiple companies and the total number of employees in each position, the top 10 positions are illustrated in bar charts as shown in Figures 2 and 3.

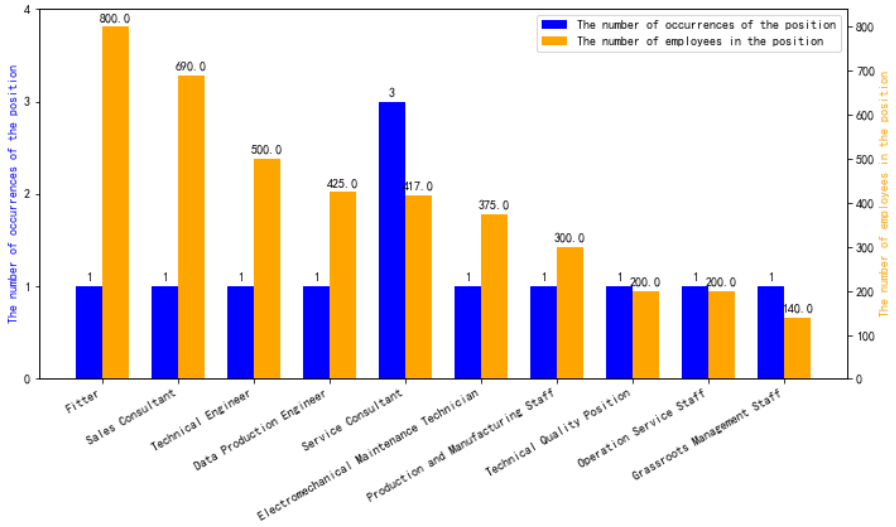

Figure 3 Bar chart of the top 10 positions in terms of number of employees and number of employees in each position

As can be seen from the figure, the test engineer position appeared 7 times in 25 enterprises, ranking first, but its employment was relatively small; although the assembly worker was mentioned only in one enterprise, it had the largest number of employees, with 800 people.

2.1.2 Job importance analysis

Table 1 Classification of important positions

Order number	Category name	Include the specific job titles
1	Software and algorithms	Car itself control software development, autonomous driving software development, software engineers, software architecture, algorithm development, perception algorithm, decision planning algorithm, control algorithm, map and positioning algorithm engineers, vision algorithm engineers, intelligent algorithm development, test, algorithm engineers, control algorithm engineers, decision planning engineers, perception algorithm engineers, software integration
2	Hardware development	Hardware engineer, vehicle hardware engineer, hardware architecture, electronic engineer, vehicle control engineer, automotive electronics engineer, embedded development, embedded engineer, electrical engineer
3	System integration development type	System integration engineer, system integration, system development, network platform development, vehicle-road coordination, functional safety, system safety engineer, application development engineer
4	Test class	Test engineer (technician), hardware test engineer, tester, test management, deployment engineer, vehicle debugging technician, test engineer
5	Intelligent driving category	Intelligent driving technology R&D engineer, autonomous driving system engineer, ADAS system R&D engineer, electronic map application engineer
6	After-sales maintenance category	Maintenance technician, mechanical and electrical maintenance technician, mechanical and electrical maintenance technician, sheet metal maintenance technician, sheet metal maintenance technician, painting maintenance technician, spraying technician, sheet metal, painting, mechanical and electrical maintenance apprentice, sheet metal maintenance apprentice, after-sales technical engineer, on-site technical after-sales engineer
7	Manufacturing	Assembly engineer, molding engineer, structural engineer, mechanical engineer, electromechanical, equipment management
8	Technical support category	Technical support, technology development, technical consultation, technical supervisor, back-end maintenance engineer, product technology position, field operation, operation engineer, scene engineer, implementation engineer
9	Research and development support	Research and development assistant engineer, research and development assistant, assistant research and development
10	Comprehensive management	Sales manager, warehouse administrator, safety management, BOM management, design change management, regulations management

In the questionnaire on job importance in Problem 41, the company mentioned 82 kinds of jobs in total[5]. These jobs were divided into 10 categories according to their core functions and highlighted the

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needs of intelligent connected automobile industry in software development, algorithm, testing and other core fields, as shown in Table 1.

The 82 jobs were marked as very important, important and generally important by 25 enterprises. Now, through the analysis of major categories, the importance heat map of these 10 categories of jobs is drawn as shown in Figure 4.

The importance of the 10 categories of jobs can be intuitively reflected by the heat map. Software and algorithm, after-sales maintenance and hardware development are ranked as the top three in importance respectively. According to this importance performance, more courses of these three categories can be added in the course arrangement.

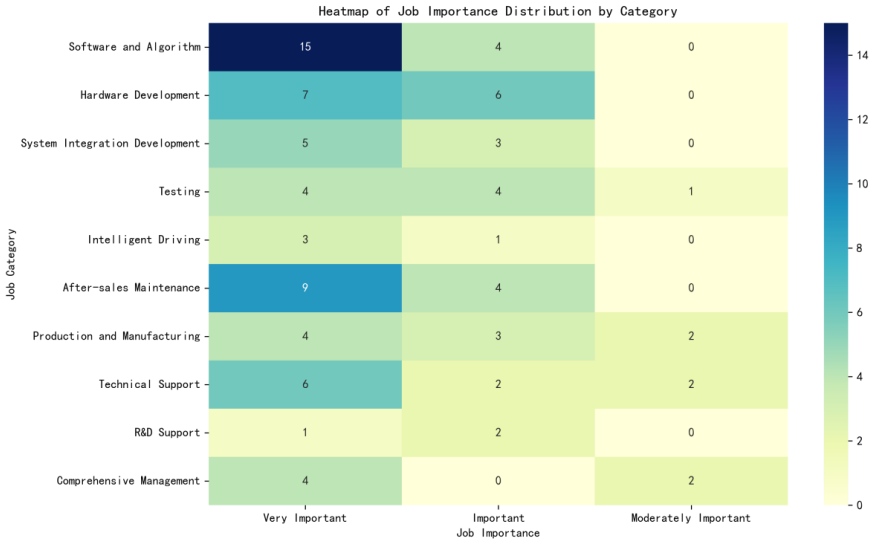

Figure 4 Heat distribution map of the importance of each category of positions

2.1.3 Job shortage analysis

In the questionnaire on job shortage in problem 42, a total of 74 kinds of jobs were mentioned by enterprises, which were grouped into 10 categories according to their importance, as shown in Table 2.

Twenty-five enterprises marked the shortage of these 74 positions with ["very short supply", "short supply", "basically meet the needs", "meet the needs"]. Now, through the analysis of major categories, the heat map of the shortage of these 10 major categories is drawn as shown in Figure 5.

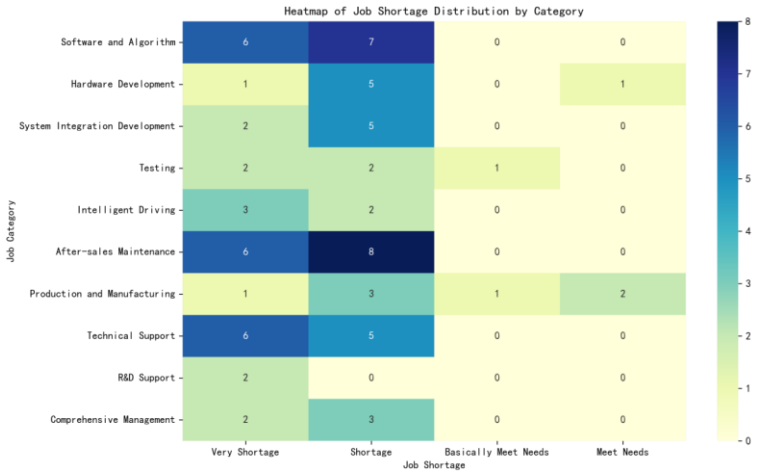

Figure 5 Heat distribution map of the shortage of various categories of jobs

The heat map can intuitively reflect the shortage demand of enterprises for these 10 categories of positions. In the figure, software and algorithm, after-sales maintenance and technical support are ranked as the top three in terms of shortage[6]. This major category of shortage is basically consistent with the previous important categories, so the course arrangement of colleges and universities can be referenced accordingly.

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Table 2 Classification of Vacant Positions

Order number	Category name	Include the specific job titles
1	Software and algorithms	Algorithm engineer, perception algorithm engineer, car control software development, software engineer, decision planning algorithm engineer, fusion positioning algorithm engineer, autonomous driving software development, application development engineer, ROS engineer, SLAM field debugging engineer, sensor calibration algorithm engineer
2	Hardware development	Hardware engineer, hardware test engineer, embedded development, embedded engineer, electronic engineer
3	System integration development	System integration, vehicle-road coordination, network platform development, communication network engineer, Internet of vehicles application engineer, system security engineer, vehicle system operation and maintenance engineer
4	Test class	Test positions, test engineers (technicians), autonomous driving test engineers, vehicle debugging technicians, experimenters
5	Intelligent driving category	Intelligent driving technology related positions, intelligent driving technology research and development engineers, ADAS system research and development engineers, autonomous driving project managers, regulatory system related positions
6	After-sales maintenance category	Sheet metal, mechanical and electrical maintenance technician, mechanical and electrical maintenance apprentice, painting, sheet metal maintenance technician, sheet metal maintenance apprentice, remote diagnosis technician, mobile service technician, painting maintenance technician, spraying technician, after-sales technical engineer, on-site technical after-sales personnel, mechanical and electrical maintenance technician, sheet metal maintenance technician
7	Manufacturing	Pilot test engineer, production line assembly calibration engineer, plastic mold engineer, mechanical engineer, installation and adjustment engineer, production process engineer, pilot workshop team leader
8	Technical support category	Technical supervisor, field technical support, field operation, operation and maintenance, service operation engineer, back-end maintenance engineer, regional technical support engineer, scenario engineer, implementation engineer, landing deployment engineer, field deployment
9	Research and development support	R&d position, R&d assistant engineer
10	Comprehensive management	Assistant for operation and sales of intelligent products for smart transportation, project manager, intelligent management of automobiles, and positions related to new energy

2.2 Knowledge/Ability/skill requirement analysis

2.2.1 Knowledge demand analysis

Question 12 lists the job titles and knowledge requirements for various positions in the respondent's company. After cleaning the data (removing non-compliant or incomplete content), 152 valid requirements were generated. These 152 requirements were analyzed, and the knowledge involved was categorized into 12 types. The frequency of each knowledge category among these 152 requirements was then counted, resulting in Table 3 showing the categories of knowledge requirements and their cumulative frequencies[7]. Using the knowledge requirement codes as the x-axis and the frequency as the y-axis, a bar chart is created to illustrate the 12 major categories of knowledge requirements and their frequencies, as shown in Figure 6.

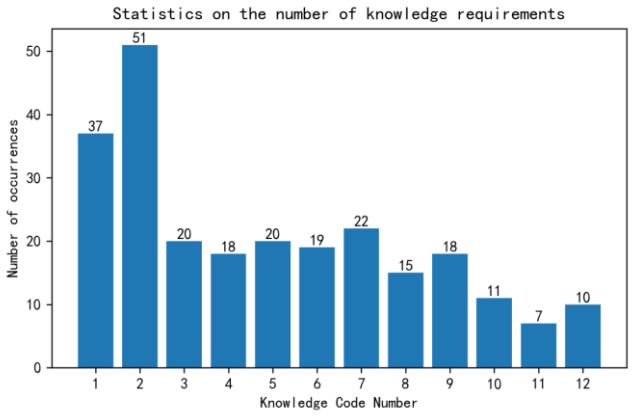

Figure 6 Statistics of the number of knowledge needs in twelve categories

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Table 3 Types of knowledge needs and cumulative times

Order number	Knowledge requirements content	Occurrence number
1	Knowledge of the structure and working principle of intelligent connected vehicles (including traditional energy and new energy).	37
2	Automobile mechanical foundation, automotive electrical and electronic foundation, automotive computer foundation, automotive network communication basic knowledge.	51
3	The structure, working principle, application scenarios, performance characteristics of typical intelligent sensors, and the basic knowledge of related intelligent sensing technology, computer vision technology, map, positioning and navigation technology.	20
4	Basic knowledge of computing platform hardware and software architecture, control logic and related decision-making system.	18
5	The typical line control chassis execution system and component structure, working principle, application scenarios, performance characteristics and related basic knowledge of execution control technology.	20
6	Intelligent cockpit system and component structure, working principle, application scenarios, performance characteristics and basic knowledge of related human-computer interaction technology.	19
7	Basic knowledge of C-V2X and vehicle-road coordination system hardware and software architecture and related network and communication technologies.	22
8	Knowledge of automotive and key system structure principles, automotive environment perception system, electronic control principle knowledge, basic knowledge of automotive key systems and components, basic knowledge of automotive electronics products, basic knowledge of vehicle maintenance, basic knowledge of vehicle and key system fault diagnosis, Linux basic knowledge.	15
9	Computer programming languages, databases and software development.	18
10	The use of various data analysis software, simulation design software and work software, including the use of CATIA, 3Dmax, CAD, PS, Arcgis and other software.	11
11	Familiar with embedded system development and automotive electronic hardware development process and tools, such as operating system principles, VerilogHDL hardware description language, Xilinx 7 series / UltraScale FPGA or ZYNQ SOC development, microcontroller technology, digital circuit technology, etc.	7
12	Other knowledge, such as English, teamwork, communication skills, learning ability, trial production process, parts management, production quality supervision knowledge, sales skills and so on.	10

From the above analysis, it can be seen that the most in-demand subjects are those with sequence numbers 2: automotive mechanical foundation, automotive electrical and electronic foundation, automotive computer foundation, and automotive network communication basics. This indicates that companies place greater emphasis on foundational knowledge; mastering solid fundamentals is essential for better service to enterprises. Next in line is sequence number 1: knowledge about the structure and working principles of intelligent connected vehicles (including traditional and new energy sources), which represents the direction of automotive development[8]. Additionally, sequences numbers 3 to 9 appear multiple times with similar frequency, suggesting that companies are increasingly focusing on software and electronic system development for intelligent connected vehicles.

2.2.2 Ability requirement analysis

Question 13 lists the job titles and skill requirements for various positions within the respondent's company. After cleaning the data, a total of 169 valid requirements were generated. Analyzing these 169 requirements, the skills involved were categorized into 21 types. Then, the frequency of each skill type among the 169 requirements was counted to produce the skill requirement categories and cumulative frequencies shown in Table 4. Using the skill requirement codes as the x-axis and the frequency as the y-axis, a bar chart is created showing the 21 major skill requirement categories and their frequencies, as illustrated in Figure 7.

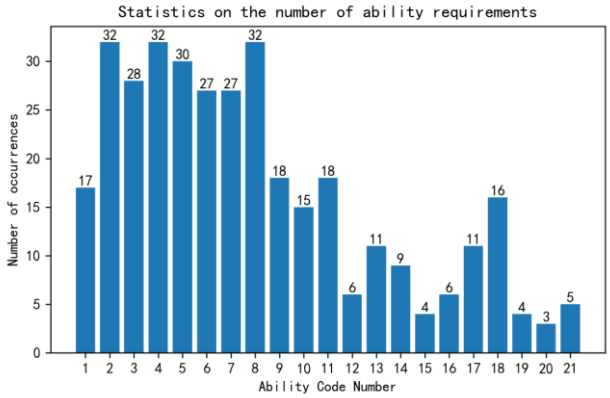

Figure 7 Statistics of the number of capability requirements in 21 categories

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Table 4 Categories of capacity requirements and cumulative times

Grade	Content of capacity requirements	occurrence number
1	Automobile electrical safety inspection and self-protection	17
2	Typical intelligent sensor vehicle installation, debugging, calibration, testing and fault diagnosis	32
3	Calculate the installation, debugging, testing and fault diagnosis of the vehicle	28
4	Typical chassis line control system and components production assembly, debugging, testing and vehicle installation, debugging, calibration, testing and fault diagnosis	32
5	Production, assembly, debugging, testing of typical intelligent cockpit system and components, vehicle installation, debugging, calibration, testing and fault diagnosis	30
6	Typical C-V2X and vehicle-road coordination system installation, commissioning, calibration, testing and fault diagnosis on the vehicle and roadside	27
7	Comprehensive testing, daily maintenance and fault diagnosis of intelligent connected vehicles	27
8	Read and draw process assembly drawings and circuit diagrams	32
9	Preparation, organization and implementation of process documents and improvement	18
10	Write test and diagnosis reports related to intelligent connected vehicles	15
11	It has the ability to manage and operate intelligent connected vehicles	18
12	Computer software development ability	6
13	Ability to understand, design, analyze and debug automotive circuits	11
14	Embedded and microcontroller system development ability	9
15	Ability to use engineering software such as 3Dmax, CAD, PS and Arcgis and simulation software	4
16	Development process of vehicle, key system and component, development tools of vehicle, key system and component, testing and testing of vehicle and environmental sensing system	6
17	Daily office skills, including literature retrieval and reading, computer and office software use, data processing, mail processing, etc	11
18	Safety and health, ability to work for a long time, ability to solve problems independently, innovative thinking, logical thinking ability	16
19	Communication skills, sales process and skill application	4
20	Have supplier management ability, BOM management ability, etc	3
21	Have basic knowledge of machinery, understand automobile and parts, have the ability to operate and run the car and disassemble and assemble the machinery	5

From the above analysis, it can be seen that the top tier of demand is for capabilities 2, 4, 5, and 8, primarily involving the installation, commissioning, calibration, testing, and fault diagnosis of intelligent sensors, smart cockpit systems and components, and chassis line control systems. It also includes the ability to read and draw assembly diagrams and circuit diagrams. This indicates that in the era of intelligent connected electric vehicles, cars will extensively use smart devices, sensors, and electronic control components, leading to a significant increase in the demand for personnel with these capabilities[9]. The second tier consists of capabilities 3, 6, and 7, which represent comprehensive testing, daily maintenance, and fault diagnosis capabilities for in-vehicle computing platforms, vehicle-to-infrastructure and vehicle-road coordination, and intelligent connected vehicles. These are unique capabilities specific to intelligent connected vehicles. The third tier includes capabilities 1, 9, 10,11, and 18, which not only cover electrical safety and vehicle operation management but also require innovation and logical thinking skills from professionals.

2.2.3 Quality demand analysis

Question 14 lists the job titles and competency requirements for various positions within the respondent's company. After cleaning the data, 136 valid requirements were generated. Analyzing these 136 requirements, the competencies involved were categorized into 14 types. Then, the frequency of each competency type among the 136 requirements was counted, resulting in Table 5 showing the competency requirement categories and their cumulative frequencies. Using the competency requirement codes as the x-axis and the frequency as the y-axis, a bar chart illustrating the 14 major competency

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requirement categories and their frequencies is shown in Figure 8.

Table 5 Quality demand categories and cumulative times

Grade	Content of demand for quality	Occurrence number
1	We firmly uphold the leadership of the Communist Party of China and China's socialist system, take the new era of socialism with Chinese characteristics as our guide, practice the core socialist values, and have a deep patriotism and pride in the Chinese nation.	17
2	They believe in the Constitution, abide by laws and disciplines, respect virtue and goodness, be honest and trustworthy, respect life and love labor, fulfill moral norms and codes of conduct, and have a sense of social responsibility and social participation.	23
3	Good quality awareness, environmental awareness, safety awareness, information literacy, craftsman spirit, innovative thinking.	32
4	Dare to struggle, optimistic personality, strong sense of collectivism and team spirit.	35
5	Healthy body, mind and personality, good fitness and hygiene habits, and good behavior habits.	16
6	A certain aesthetic and humanistic accomplishment, 1~2 artistic specialties or hobbies.	14
7	Good communication skills	17
8	Have good professional quality and service consciousness, love their job, work attitude is rigorous, have a sense of responsibility and progress, can endure hardship, can tolerate loneliness	38
9	Strong learning ability, lifelong learning, hard research	24
10	Stable emotion, strong ability to work under pressure	3
11	Have a sense of confidentiality	1
12	Have a solid theoretical foundation and information processing ability	three
13	Have independent thinking and strong logical thinking ability, strong problem analysis and solution ability, strong sense of time, high work efficiency	four
14	High loyalty	2

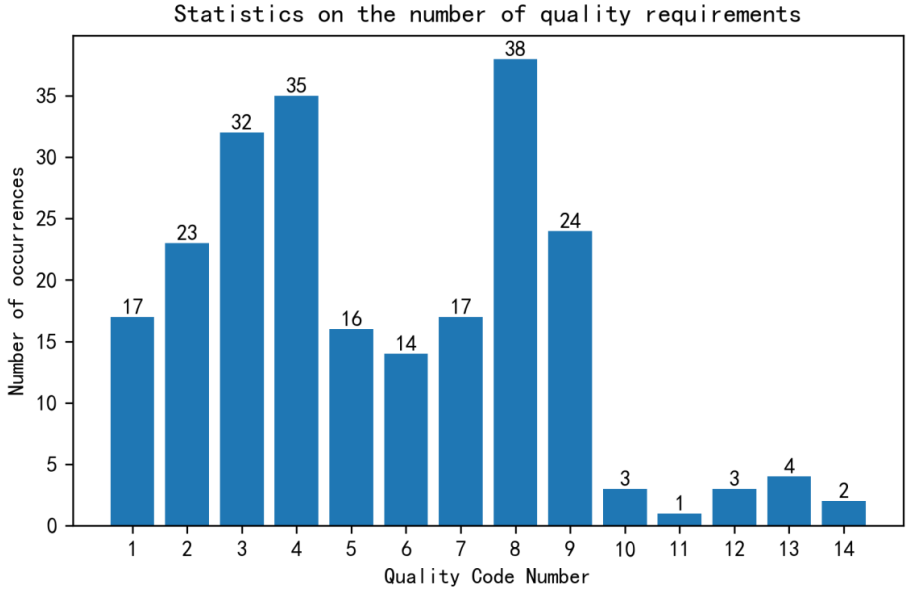

Figure 8 Statistics of the number of quality requirements in 14 categories

From the above analysis, it can be seen that Quality Requirement No.8 appears most frequently, indicating that this is one of the most basic and important requirements for employees. Employees with good professional ethics can be dedicated to their jobs, approaching work with a rigorous attitude and a strong sense of responsibility[10]. Their qualities of hard work and endurance in solitude help them persist in challenging or monotonous working environments, thereby creating value for the company.

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The fourth requirement is that employees should maintain a positive and optimistic attitude, pay attention to collective consciousness and strengthen teamwork when facing difficulties and challenges at work, which is conducive to overcoming difficulties. The quality awareness mentioned in Requirement 3 is the lifeline of a company. Environmental consciousness aligns with sustainable development requirements, while safety awareness is crucial for safeguarding employee health and ensuring the smooth operation of the enterprise[11]. Information literacy and craftsmanship can enhance production efficiency and product quality, whereas innovative thinking enables companies to maintain competitiveness in fierce market competition.

Later, more emphasis was placed on Learning Ability No.9 and Social Responsibility No.2. These two qualities not only meet the demands of rapid knowledge and technological updates in today's fast-paced era, supporting corporate innovation and development; they also ensure lawful and compliant operations, better safeguarding the company's image and reputation, and promoting harmonious development between the company and society.

The top three requirements of knowledge, ability and quality are integrated together to draw a radar chart as shown in Figure 7. The radius of the circle in the Figure 9 represents the number of times the requirements appear, and the more times they appear, the more important they are.

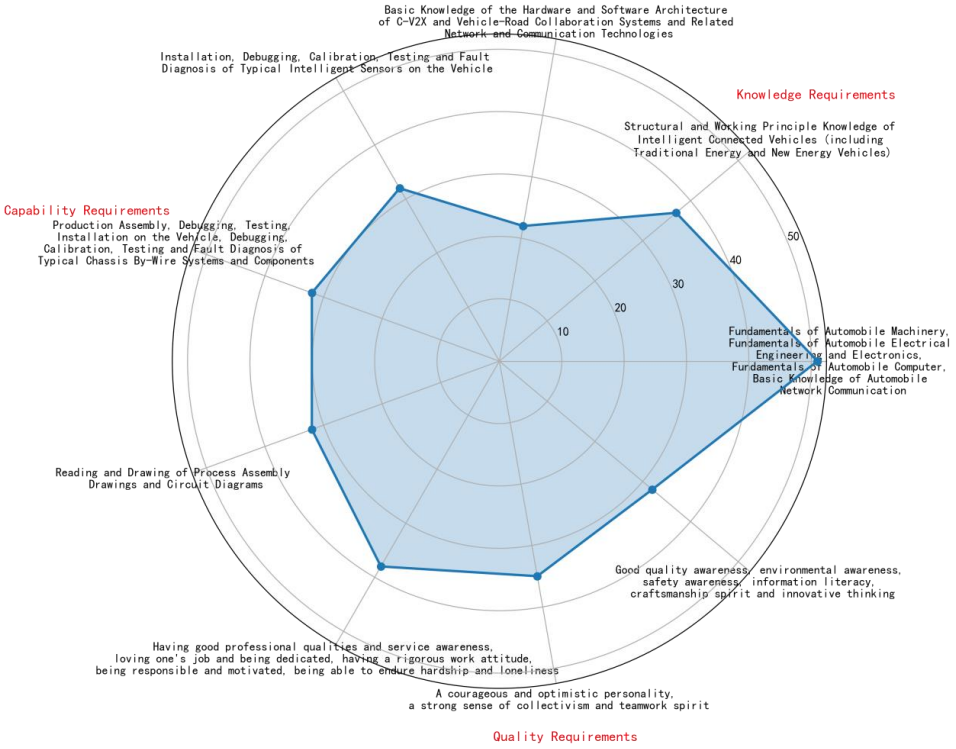

Figure 9 Radar chart of the top three requirements for each type

3. Summary and Suggestions

This paper employs large-scale AI models combined with python programming and other methods to analyze corporate survey questionnaires. The models used include DouBao, Tencent Yuanbao, DeepSeek, etc., such as the results referenced when categorizing various needs and positions. python language programming is mainly used for data statistical processing and result visualization. After analysis, we have gained an understanding of the operating time and personnel distribution of the enterprises involved in the survey, the job distribution of vocational college automotive electronics professionals in these enterprises, as well as the knowledge, ability, and quality requirements that enterprises have for vocational college intelligent network automotive professionals[12]. This has positive guiding significance for colleges and universities in formulating training plans.

At the knowledge level, on the one hand, the curriculum of colleges and universities should keep up with the latest standards and technological development of the industry and timely introduce the latest intelligent connected vehicle content; on the other hand, it should strengthen basic knowledge, especially

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professional basic knowledge such as computer, electronic circuit and mechanical drawing. In terms of ability, on the one hand, students should be improved in the practical ability of intelligent connected vehicles, especially related to intelligent sensors and electronically controlled chassis; on the other hand, students should be strengthened in the ability of reading and drawing assembly drawings and circuit diagrams. In terms of quality, colleges and universities should not only strengthen the professional ethics education of students and cultivate their dedication spirit, but also strive to improve students' awareness of quality, environmental protection, safety, information literacy, craftsman spirit and innovative thinking, so that the cultivated students become professional talents with high ability and high quality.

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