

# ***Research on Upgrading Path of Major under the Background of New Infrastructure: A Case Study of Intelligent Management of Water Conservancy and Hydropower Projects***

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**Abstract:** The development of new infrastructure and industry has put forward new requirements for the training of traditional water conservancy professionals, and it is an inevitable trend to carry out professional transformation and upgrading with the support of new technologies. According to the new requirements of the new infrastructure, the characteristics of the upgrading and transformation of water conservancy majors are mainly reflected in two aspects: first, the integration of traditional water conservancy engineering majors with new technological development and new industry needs; second, the cultivation of composite high-quality talents with the intelligent application ability of the whole life of water conservancy projects. It is mainly achieved through upgrading the personnel training and innovating the training mode, restructuring the curriculum system, reforming the teaching methods, cultivating high-level teaching teams, building public training bases, enhancing social service capabilities.

## **1. Introduction**

The report to the 20th National Congress of the CPC stressed accelerating the implementation of the innovation-driven development strategy. The new type of infrastructure is an important part of the modern infrastructure system and an important support for implementing the innovation-driven development strategy and promoting high-quality economic and social development.

Guided by new development concepts, driven by technological innovation and based on information networks, the new type of infrastructure is a material engineering facility that provides basic and public services in digital transformation, intelligent upgrading, integrated innovation and other fields<sup>[1]</sup>. Integrated infrastructure mainly refers to the infrastructure form formed after the application of the new generation of information technology to the intelligent transformation of traditional infrastructure. The emphasis of intelligent transformation in different fields is different. In terms of environmental and resource facilities, we need to improve the monitoring, early warning,

forecasting and remote control capabilities of major rivers, lakes and reservoirs, and water resources, promote intelligent upgrading and joint operation of water conservancy facilities, and improve our ability to cope with natural risks under uncertain conditions.

## **2. Background of the renovation and upgrading of intelligent management of water conservancy and hydropower projects**

Under the background of new infrastructure construction, the water conservancy industry is facing huge changes and transformations. Intelligent water conservancy construction is one of the important ways to promote the high-quality development of water conservancy in the new era<sup>[2]</sup>. At the same time, new requirements are put forward for the training of water conservancy professionals, which is also reflected in the new professional education catalog, and the major of Water Conservancy and Hydropower Engineering Management is renamed the major of Intelligent Management of Water Conservancy and Hydropower Engineering. According to the new situation of strengthening the construction of "smart water conservancy" in the water conservancy industry, the intelligent management major of water conservancy and hydropower engineering should have the ability to apply information technology such as Internet of Things technology and modern communication technology in order to meet the new requirements of related posts such as water resources management, water conservancy project construction and water conservancy project operation management. Especially in flood control, drainage, water supply, sewage treatment and water environmental protection and other water conservancy work, can use advanced technical means to carry out intelligent analysis, judgment and treatment. To sum up, compound talents who understand water conservancy and have information literacy are the training direction for intelligent management professionals of water conservancy and hydropower projects under the background of new infrastructure construction.

According to the Analysis and Research on the Matching between the Demand for Talents in Water Conservancy Industry and the professional setting of vocational colleges issued by the Steering Committee of Water Conservancy Vocational Education and Teaching, there are nearly 20 water conservancy and hydropower engineering management majors in higher vocational colleges, and the number of graduates is about 900 each year. The scale of talent training is generally stable, but it cannot meet the needs of the development of water conservancy industry<sup>[3]</sup>. Through the investigation of water conservancy industry and enterprises, it is concluded that the training objectives of water conservancy professional talents meet the needs of the development of water conservancy industry talents. However, from the perspective of enterprises, the innovative consciousness and innovative spirit of graduates need to be strengthened. At the same time, the talent training program of intelligent management major of water conservancy and hydropower engineering in vocational colleges across the country is analyzed, and it is preliminarily concluded that there are still problems such as "difficult, expensive and wide" in professional talent training.

### **2.1. Personnel training specifications do not adapt to the digital transformation and upgrading of water conservancy industry (wide)**

New water conservancy infrastructure involves new technology, wide range of knowledge and wide fields. In the process of digital transformation and upgrading of water conservancy, the trend of cross-integration of multi-disciplines and multi-majors is becoming more and more significant, and the requirement for training composite talents is getting higher and higher. However, the time of professional students in school is short, the mechanism of cross-disciplinary training is still difficult to effectively form, and it is difficult for students to carry out cross-disciplinary teaching organizations. The cultivated talent specifications are difficult to meet the requirements of compound

talents who can adapt to the digital transformation and upgrading of water conservancy industry.

## **2.2. The curriculum system and teaching content cannot accurately connect with the construction and management of smart water conservancy (difficult)**

The construction of smart water conservancy has brought about the constant change of positions and skills in the water conservancy industry. BIM (building information model) engineering, intelligent monitoring and intelligent management of water conservancy engineering and other positions require students to have relevant new knowledge and skills. With the in-depth application of new technologies such as drones, big data and artificial intelligence in the industry, the water conservancy industry has been applying. The knowledge system, vocational skills, new standards and new norms in the field of water conservancy industry are constantly changing, and the current professional Settings and course content of vocational colleges are difficult to respond to the new requirements of the industry in a timely manner.

## **2.3. Training conditions and resources cannot meet the needs of information technology development (expensive)**

The intelligent equipment, new infrastructure platform and intelligent management software that need to be invested in the construction of intelligent management of water conservancy and hydropower engineering are expensive, and huge investment has been made for technical training platforms such as intelligent construction, digital cost, intelligent operation management and digital twin of water conservancy and hydropower engineering. To cultivate complex high-quality and skilled talents in connection with intelligent water conservancy, it is necessary to rely on the government, the bank, the school and the enterprise to carry out all-round cooperation in the whole process of talent training, and to achieve an all-round integration of the supply and demand of higher vocational talent training through the joint construction of hardware training bases and software environment. However, at present, the deep cooperation between schools and enterprises is seriously affected by the problems such as the surface of co-education talents, the insufficient service ability of higher vocational colleges, the insufficient investment in enterprise facilities and the immature mechanism for sharing results.

On the whole, the upgrading and transformation of intelligent management of water conservancy and hydropower engineering, which meets the requirements of new infrastructure, is very distinctive and worthy of in-depth study and practice.

## **3. The transformation and upgrading of intelligent management of water conservancy and hydropower engineering**

We hope that through the transformation and upgrading of intelligent management of water conservancy and hydropower engineering, we can cultivate talents in short supply in the digital era of water conservancy industry, and at the same time provide references for the transformation and upgrading of traditional water conservancy.

## **4. Ideas and measures for the renovation and upgrading of intelligent management of water conservancy and hydropower engineering**

### **4.1. General ideas**

According to the requirements of new infrastructure construction, the characteristics of the upgrading and transformation of intelligent management of water conservancy and hydropower engineering are mainly reflected in "two emphasizes" : first, emphasize the integration of new development of profession and technology and new needs of industry; Second, it emphasizes the cultivation of compound high-quality talents with intelligent application ability in the whole life cycle of water conservancy and hydropower projects (design-construction-operation and maintenance). The methods we explored include: improving the practical education system, restructuring the curriculum system, reforming teaching methods, cultivating high-level structured teaching innovation teams, building public training bases for wisdom sharing, and strengthening industry-university-research and innovation.

### **4.2. Specific measures**

According to the general idea, the specific implementation will be as follows.

#### **4.2.1. Carry out the pilot of modern apprenticeship system and improve the practical education system**

In order to carry out the pilot of modern apprenticeship, the school, together with Zhejiang Water Conservancy and Hydropower Project Management Association and related enterprises, established a 1+1+N talent training community. Through the joint recruitment and training of schools and enterprises, we have carried out the reform of the school-enterprise integration education model, and improved the relevant systems, and finally formed a long-term mechanism of the integration of production and education and school-enterprise cooperation. Students are encouraged to improve their ability of innovation and entrepreneurship by participating in the scientific research or production projects of their tutors.

#### **4.2.2. Reconstructing the curriculum system by integrating the course post competition certificate**

In order to meet the needs of the industry and job groups, we organized a talent training program demonstration meeting, and added courses such as UAV application, BIM, intelligent monitoring and maintenance of hydraulic engineering to the talent training program. The new curriculum system is a three-level structured curriculum system combining education and training, which can meet the requirements of intelligent water conservancy construction. Focusing on modern water conservancy cutting-edge technologies such as BIM technology, surveying and mapping geographic information, intelligent monitoring, digital scheduling, etc., we optimized the teaching content of the course. In order to realize the integration of positions, certificates and courses, and enhance the flexibility, adaptability and pertinency of talent training, the school and enterprises have jointly developed the combination of chemical education and training course packages of modules such as intelligent construction and digital supervision, and have also introduced 1+X teaching resources such as drones, building information models, and water environment testing to build new teaching materials.

#### **4.2.3. Reform the teaching method, and build multi-form intelligent thinking and politics into the golden course**

Professional courses such as "Operation and Maintenance of Water Conservancy Project", "Intelligent Management of Water Conservancy Project", "Flood Control and drought control", and so on, use the virtual simulation practical training platform of water conservancy project management to reproduce real jobs, environments, processes and tasks such as water conservancy project operation and management posts through virtual scene simulation, and carry out virtual simulation practical teaching. Construction courses such as "Water Conservancy Engineering Construction Technology" and "Engineering Geology and foundation Treatment" rely on the Internet of Things and 5G technology to build remote online live broadcasting sites, promote remote collaboration and real-time interactive teaching. Enterprise tutors show the project site online, demonstrate and explain the construction technology, and campus tutors provide itinerant guidance and auxiliary teaching. Explore teaching and learning, teaching and teaching, learning and learning interactive teaching activities.

At the same time, we should implement the idea of cultivating talents by virtue, meet the professional quality requirements of intelligent water conservancy for technical talents, organize teachers to base on professional courses, deeply explore the educational elements contained in the courses, make micro-course resources for ideological and political education, compile teaching cases for ideological and political education, summarize teaching methods for ideological and political education, and integrate ideological and political education into the whole course teaching process in the form of fusion micro-irrigation. We imperceptibly and silently carry out ideological ethics and professional ethics education for students to achieve a high degree of integration and resonance of vocational skills training and value guidance.

#### **4.2.4. Implement four talent plans to cultivate a high-level structured teaching innovation team**

We implement the "Leading Goose" program to cultivate high-quality professional leaders, flexibly introduce one industry leader to serve as an off-campus professional leader, and select two young and middle-aged backbone teachers as backup professional leaders. Professional leaders are trained through temporary exchange and party building work in the branch.

The "lift" plan has been implemented to build a high-level talent training team, comprehensively improve the teaching ability, professional practice ability, technology research and development ability and modern information technology application ability of teachers in professional groups, and focus on cultivating four modular teaching teams of professional courses through mutual training and sharing between schools and enterprises. Relying on Dayu Modern Apprenticeship College, cultivate a professional "double tutor" team combining high-level apprenticeship system.

In order to cultivate a high-level innovative service team, the implementation of the "Phoenix" program. We bring in 2 professional core curriculum teachers. Flexible introduction of 2 industry enterprises' chief experts (famous), technicians, the establishment of master studios, master technology leadership and master skills inheritance role. We have also built four high-level technical service teams, namely, production service team, technical training team, skill identification team and science popularization education team.

The "double-qualified" teacher training base is constructed by implementing the "integration" plan. The system of mutual employment, mutual training and sharing of school-enterprise talents in Dayu Modern Apprenticeship College has been deepened, such as the flow mechanism of part-time and part-time salaries for school-enterprise personnel and mutual employment. The "double teacher" training base in the two professional fields of wisdom construction and wisdom supervision has been

completed.

#### **4.2.5. Build a wisdom sharing public training base to help the transformation and upgrading of smart water conservancy**

In response to the digital transformation of the water conservancy industry and the requirements of smart water conservancy construction, the university and the subordinate units of the Water Conservancy Department of Zhejiang Province have built and shared the public training base of Zhejiang water conservancy industry to solve the problem of huge investment in technical training platforms such as intelligent construction, digital cost, intelligent operation management and digital twin for water conservancy and hydropower projects. The base provides water disaster prevention exercises and flood and drought disaster experience education for the whole province, hoping that the base can become a model of public training base for water disaster prevention in the Yangtze River Delta region. With the comprehensive application of cloud computing, big data, Internet of Things and other technologies, we have developed a virtual simulation training platform for watershed that integrates intelligence, visualization, and all-factor perception. The platform includes business systems such as flood control, resources, hydrology, and engineering operation and maintenance, which can provide online training such as engineering cognition, water situation monitoring, flood control and dispatching, intelligent supervision, and safety monitoring. The platform also has the function of connecting to the real scene according to the teaching needs and connecting with the real engineering cloud, solving the trilemma problem of "difficult to implement, difficult to observe and difficult to reproduce" of water and drought, and training students' skills by combining virtuality and reality.

#### **4.2.6. Strengthen the collaborative innovation of industry-university-research and innovation, and enhance the professional social service ability**

Focusing on the requirements of efficient and intelligent supervision, the school and enterprise jointly build a collaborative innovation center for water conservancy intelligent supervision, and use advanced technologies such as the Internet of Things, artificial intelligence, 5G, and drones to carry out technical research, industry application guidance and training in digital watershed, digital management of water conservancy projects, and other aspects to help the digital transformation of water conservancy.

Relying on the Master Studio, we provide special technical training services such as flood and drought disaster prevention, project operation and management, and boost the quality of talents in enterprises. Relying on the Master Studio, we carry out training and skill appraisal of high-skill talents such as BIM technology, drone driving, intelligent operation and maintenance of water conservancy projects, and promote the transformation and upgrading of enterprises. It undertakes 1,000 training, education and skill appraisal every year, and has become a major training center for intelligent water conservancy technical and skill talents in the Yangtze River Delta.

### **5. Effect of renovation and upgrading of water conservancy majors**

#### **5.1. Professional construction effect**

The major was selected as the first batch of water conservancy quality majors, and the team teachers participated in the professional introduction and professional teaching standards revision (system) of the intelligent management major of Water conservancy and hydropower engineering of the Ministry of Education, and set up 3 kinds of national planning textbooks in the 14th Five-Year Plan, 1 national online quality course, 5 provincial quality online open courses, 3 provincial



ideological and political demonstration courses, and 1 course ideological and political research project. Won 2 first prizes and 1 second prizes in the National Water Conservancy Vocational college teachers' teaching ability competition, won 1 second prize and 1 third prize in the national Water conservancy vocational college ideological and political teaching case of water conservancy courses, won 1 special prize (student) and 3 second prizes in the Zhejiang Provincial College Ideological and political micro-class Competition. We led the establishment of Zhejiang Water Conservancy industry public training base and the Yangtze River Delta green ecological integration development industry education Alliance, and jointly built Pakistan's hydropower operation and maintenance training base with Pakistan Renewable Energy Technology Agency. We organized a smart water forum.

## **5.2. Quality of personnel training**

The students' professional skills and innovation ability have been significantly improved. In the past three years, they have won two second prizes and one third prize in the National Vocational College Skills Competition. The National College students Advanced Mapping Technology and Product Information modeling innovation Competition has 4 first prizes, 10 second prizes and 6 third prizes; 4 first prizes, 9 second prizes and 42 third prizes in provincial and ministerial vocational college skill competitions; Won the silver award of provincial innovation and entrepreneurship competition 1, group third prize 5. The average employment rate reached more than 98%, through the tracking survey of nearly half a year shows that the graduates of this major, enterprises generally think that they can put into work in a short time, and can independently undertake the corresponding design, management and other tasks, comprehensive quality is high, employment satisfaction is rising year by year.

## **5.3. Demonstration affects experience promotion**

We successfully co-organized the 9th National Water Conservancy Industry Vocational Skills Competition and hosted the second Ningbo Water Conservancy Industry Vocational Skills Competition. The virtual simulation and training platform of water conservancy project management technology independently developed was the only platform for the competition; Jiangsu Construction Vocational Technical College, Anhui Water Conservancy and Hydropower Vocational Technical College, Yangtze River Engineering Vocational Technical College, provincial Qiantang River Basin Center, Ningbo Water Conservancy and Hydropower Planning and Design Institute and many other brother colleges and units have come to our college to exchange professional construction, school-enterprise cooperation and other related matters, and the industry and social influence has been increasing.

## **6. Prospect of further reform in the future**

In order to meet the new needs of the industry and the new development of technology in the new era, the school-enterprise integration mechanism should be further improved, and relevant policies should be introduced to encourage and promote more leading enterprises in the industry to deeply participate in supporting professional construction and personnel training<sup>[5]</sup>. The financial support for the construction of new infrastructure-related majors should be further increased. For example, the construction of virtual simulation training platform, gold course and new form teaching materials and practice bases requires certain investment, but the current professional construction funds are much different from the funds required for high-level professional construction.

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