

# Analysis of the Catalogue Upgrading and Digital Transformation of Meteorological Majors in Vocational Education in the Context of "Intelligent Meteorology Plus"

Quan Xia<sup>1</sup>

<sup>1</sup> Lanzhou Resources & Environment Voc-Tech University, Lanzhou, Gansu, China

<sup>1</sup> Yellow River Basin Ecotope Integration of Industry and Education Research Institute, Lanzhou, Gansu, China

<sup>1</sup> Laboratory of Climate Resource Development and Disaster Prevention, Lanzhou, Gansu 730021, China

## ABSTRACT

With the arrival of the era of "Intelligent Meteorology Plus", the intelligent upgrading of the meteorological industry has become a trend in industry development, and in this context, new technologies, new business forms, and new professions continue to emerge. How to cultivate high-quality applied meteorological professionals to adapt to industrial upgrading and market demand changes is a challenge faced in the reform and development of vocational education meteorological professional cultivation. The major catalogue is an important basis for various vocational colleges to carry out education and professional cultivation. The adjustment of the major catalogue is a fundamental and strategic task to adapt to the construction of the national modern industrial system, connect with development needs, serve new industries and new business models, and promote the supply-side structure reform of vocational education professionals. This paper mainly focuses on the transformation issues of professional demand brought about by technological development and industrial upgrading in the cultivation of meteorological professionals in vocational education. Guided by promoting employment and adapting to the needs of industrial development, it also studies the industrial applicability of the revised catalogue of meteorological majors in vocational education.

**Keywords:** Vocational education, Digital transformation, Revision of the major catalogue, Professional cultivation.

## 1. INTRODUCTION

The current Chinese economy and industry have entered a stage of high-quality development, with rapid technological advancements, especially the rapid iteration and penetration of the new generation of information technology into various industries, bringing about changes in the industrial ecology and technological models of industry enterprises. New technologies, new business forms, and new professions are constantly emerging, and the current vocational education major catalogue can no longer meet the professional training needs of the digital economy era.[1] The major upgrading and digital transformation of vocational education

have practical significance for optimizing the supply-side structure of Chinese professionals.[2][3]

In recent years, the combination of new generation information technologies such as the Internet of Things, big data, and artificial intelligence with meteorology has promoted the intelligent upgrading of the meteorological industry and the development of meteorological services towards intelligence. The era of "Intelligent Meteorology Plus" has arrived and the demand for meteorology in various industries is increasing. The commercial value of meteorology is also constantly being explored. The employment demand of meteorological industry enterprises has undergone significant changes and the demand for composite meteorological professionals with digital hands-on

ability, digital professional ability, and digital knowledge structure is increasing.[4][5][6] Based on the research on the intelligent upgrading of the meteorological industry, this study summarizes the problems of mismatch, disconnection, and incompatibility between the current quality of meteorological professional cultivation in vocational education and the development of meteorological intelligence. Taking the revision of the major catalogue of meteorology in vocational education as the starting point, this study aims to connect with the development of meteorological technology and changes in market demand, reflecting the digital transformation of the major catalogue,[7][8] focusing on the changes in current and future technological, business forms, and post competency requirements, enabling vocational education meteorological professional cultivation to adapt to the needs of industrial development.[9][10][11]

## **2. ANALYSIS OF THE BACKGROUND OF METEOROLOGICAL (INDUSTRY) DEVELOPMENT**

### **2.1 *New Situation of Meteorological (Industry) Development***

#### **2.1.1 *New Business Models Brought About by the Comprehensive Meteorological Service Reform at the County Level of National Meteorological Departments***

In 2013, the China Meteorological Administration issued the Opinions on the Reform and Development of County-level Comprehensive Meteorological Services (hereinafter referred to as the Opinions), which put forward requirements for developing county-level comprehensive meteorological services, accelerating the construction of intensive county-level comprehensive meteorological service platforms, promoting county-level comprehensive meteorological service reform, and increasing scientific and technological support for county-level comprehensive meteorological services and professional guarantee. The Opinions point out that "To promote the reform and development of county-level comprehensive meteorological services, we must adhere to the direction of public meteorological development, focus on serving economic and social development and ensuring people's safety and well-being, adhere to the

principles of adapting to needs, intensive and efficient, scientific and technological support, and adapting to local conditions, adhere to advanced, comprehensive, stable, practical, convenient, and open technological routes, aim to improve basic service capabilities, optimize service layout, and adjust service division of labor, and improve the business process as the main line, with a focus on developing comprehensive meteorological services, building a comprehensive meteorological service platform, reforming the meteorological service system, strengthening scientific and technological support and professional guarantee, and avoiding low-level redundant construction and labor, so as to form county-level comprehensive meteorological services with integrated business, intensive functions, and multiple post responsibilities, comprehensively promote the modernization of grassroots meteorological services, and continuously enhance the comprehensive strength, innovative vitality, and influence of county-level meteorological institutions in meteorological work". Through the reform of county-level comprehensive meteorological services, the division of labor at the provincial, prefecture (city), and county levels will be adjusted to improve the management level of county-level comprehensive meteorological services. The establishment of comprehensive service posts at the county level is also more scientific and reasonable, adhering to the principles of one person with multiple posts, one post with multiple responsibilities, and improving work efficiency, so as to achieve the comprehensive and intensive development of various services such as public meteorological services, meteorological forecasting, meteorological observation, and comprehensive meteorological support in county-level meteorological institutions.

#### **2.1.2 *Intelligent Transformation and Upgrading of the Meteorological Industry with Constant Emerging New Technologies***

With the advancement of technology, especially the continuous development of new technologies such as the Internet of Things, cloud computing, mobile Internet, big data, and artificial intelligence, profound and even disruptive changes are happening in various industries, including the meteorological industry. In this context, the concept of "Intelligent Meteorology" has emerged. Intelligent Meteorology relies on the progress of meteorological technology to make the meteorological system a system with self-

perception, judgment, analysis, selection, action, innovation, and adaptive capabilities. The 13th Five-Year Plan for National Meteorological Development and the National Meteorological Modernization Development Outline (2015-2030) both propose "to promote the modernization of meteorological construction with Intelligent Meteorology as an important symbol and achieve intelligent observation, accurate forecasting, efficient service, advanced technology, and scientific management of Intelligent Meteorology". The Action Plan for the Development of Intelligent Meteorological Services (2019-2023) issued by the China Meteorological Administration proposes that "By 2023, information technologies such as big data, cloud computing, and artificial intelligence should be fully applied in meteorological services, preliminarily achieving the transformation of meteorological service product production from manual labor to intelligent production, the transformation of service mode from one-way push to two-way interaction, and the transformation of service system from low dispersion and repetition to intensification, so as to initially form a new type of intelligent meteorological service development ecosystem that includes intelligent perception, precise ubiquity, situational interaction, and inclusive sharing". The Leading Plan for the Development of Meteorological Observation Technology (2020-2035) and the Development Plan for Meteorological Informatization (2018-2022) propose "to promote the development of meteorological observation technology towards automation, informatization, and intelligence", "to improve the intelligent monitoring capability of artificial weather modification to support meteorological forecasting and early warning based on artificial intelligence", and "to promote the intelligent development of meteorological forecasting based on big data for meteorological impact forecasting", so as to integrate meteorological forecast products into the development of intelligent agriculture, intelligent environmental protection, intelligent water conservancy, intelligent transportation, intelligent energy, intelligent city, and other intelligent fields. "Intelligent Meteorology" has become the main trend in the future development of the meteorological industry.

### *2.1.3 New Professions Born from the Development of China's Commercial Meteorological Service Industry*

With the rapid development of China's social economy, the relationship between meteorology and national economy and people's livelihood is becoming increasingly close. The impact of meteorological services on economic construction, social development, and people's lives is becoming increasingly evident. With the improvement of social meteorological awareness and concepts, meteorological services have gradually shifted from simply providing meteorological information services to generating economic benefits through social productivity, playing an increasingly important role in promoting economic construction, social development, and people's production and life, as well as in prevention and reduction of natural disasters and responding to climate changes. At the same time, meteorological services have economic attributes beyond public welfare, and can obtain corresponding benefits through reasonable investment. Meteorological services are divided into basic meteorological services, paid meteorological services, and commercial meteorological services. Commercial meteorological services are market-oriented meteorological services aimed at profitability. According to statistics, the commercial meteorology in Europe reached 260 billion US dollars in 2018 and the commercial meteorology in the United States also reached 160 billion US dollars. The commercial meteorological market in Europe and America is developing rapidly, with outstanding companies in prevention and reduction of natural disasters, insurance, service intelligence, and other areas, becoming unicorn enterprises.

In 2015, in order to accelerate the open sharing of data and deepen the application of big data, the State Council officially issued the Implementation Outline to Promote the Development of Big Data, which pointed out "the need to promote the interconnection and sharing of public data in China". Vice Premier Wang Yang also made clear requirements for accelerating the open sharing of meteorological data. In the same year, the China Meteorological Administration officially released the Basic Meteorological Data and Product Sharing Catalogue, providing 17 types of basic meteorological data and products for free to the whole society. The door to China's meteorological business gradually opened and many excellent meteorological service companies such as Moji

Weather and Xiangji Technology emerged. In 2018, Xiangji Technology announced a Series B financing of 116 million yuan, providing authoritative, high-quality, and rich on-demand customized commercial meteorological services to weather-related industries such as environmental protection, power grid, transportation, insurance, and new retail, becoming a leader in meteorological technology enterprises serving the modern economy. At present, the commercialization of

meteorology in China is still in its early stages, and the commercial value of meteorology is constantly being explored. As a country with severe meteorological disasters and a huge real economy, China has the same huge market potential as European and American countries. The commercialization of meteorological services is an inevitable trend for the future development of China's meteorological service industry (see "Figure 1").

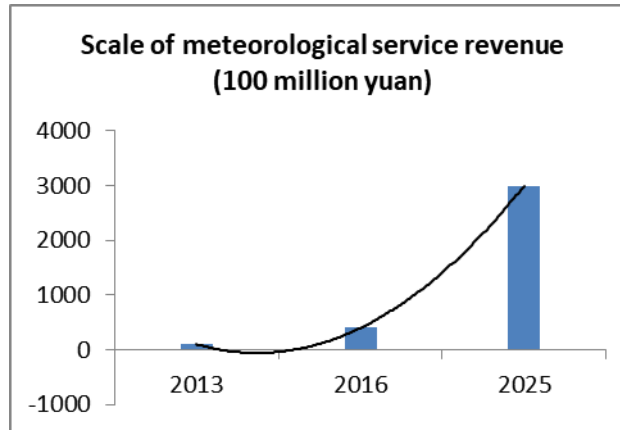


Figure 1 Revenue scale and development trend of China's meteorological service industry from 2013 to 2025 (unit: 100 million yuan).

## 2.2 New Changes in the Demand for Meteorological Professionals in Related Industries

### 2.2.1 The Need for Technical and Skilled Personnel with Comprehensive Service Capabilities in Grassroots Meteorological Station Operations

As of the end of 2019, there were a total of 2,424 meteorological observation stations in China (including 1,195 arduous meteorological stations, accounting for approximately 49%). After the comprehensive meteorological service reform at the county level, grassroots meteorological stations have transformed from single service posts such as observation and forecasting posts to comprehensive meteorological service posts. At present, the main posts set up include comprehensive meteorological service posts and comprehensive meteorological management posts. The comprehensive meteorological service posts mainly involve meteorological prediction and forecasting, prevention and reduction of natural disasters, meteorological services, comprehensive meteorological observation, meteorological data quality control, maintenance and repair of

meteorological instrument and equipment, artificial weather modification, and other work, which require the service technical personnel to have one specialty with multiple skills, as well as a great demand for composite technical skilled personnel. The staff of the comprehensive meteorological management posts should not only possess professional meteorological knowledge and skills, but also possess certain management abilities.

### 2.2.2 The Increasing Demand for the Support and Maintenance of Meteorological Instrument and Equipment Due to the Intelligent Development of Meteorological Services

Since the automation of meteorological department observation service, the demand for meteorological observation posts has significantly decreased. However, at the same time, observation automation relies on data quality and stability, and the maintenance and repair of meteorological observation instrument and equipment is also the foundation for ensuring automatic observation services. At present, there are approximately 60,000 automatic observation stations nationwide and there is a high demand for equipment support. Not only

the meteorological departments, but also meteorological instrument and equipment manufacturers need to install and maintain the sold instrument and equipment in the later stage. There is a high demand for personnel in the equipment maintenance and debugging posts.

### *2.2.3 The Demand for High-level Composite Meteorological Professionals Brought About by the Rise of Meteorological Commercial Service Industry*

The demand for meteorological services in various industries is constantly increasing, the commercial value of meteorological services is being explored, and meteorological technology service companies are developing rapidly. However, currently, meteorological technology service companies have high requirements for the development and technical personnel of meteorological service products in programming, computer applications, big data analysis, and other aspects. Meteorological students don't have an advantage in information technology and programming, and most of the existing technical personnel have a background in computer science. Meteorological technology service companies need composite professionals who not only know about meteorology, but also possess information technology and programming skills.

## **3. THE CURRENT SUPPLY SITUATION AND SHORTCOMINGS OF METEOROLOGICAL PROFESSIONALS**

Under the trend of deep integration of meteorology and economic and social development, as well as intelligent upgrading of the meteorological industry, traditional meteorological industry (meteorological and civil aviation departments) service models are constantly upgrading, emerging meteorological industries (such as Xiangji and Moji) are constantly emerging, the demand for meteorological services is expanding, the commercial value of meteorology is constantly being explored, the employment channels for meteorological professionals are constantly expanding, and the traditional professional training model can no longer meet the urgent need for improving the quality of meteorological professionals brought about by the

development of meteorological technology. In this context, there are mainly the following shortcomings in the supply of meteorological professionals.

### ***3.1 The Changes in Professional Demand Direction Brought About by the Service Model Adjustments***

The county-level comprehensive service reform of meteorological departments has new requirements for post abilities, requiring professional composite technical and skilled personnel with strong comprehensive service capabilities. In addition, the main professional demand for meteorological equipment maintenance and repair is for meteorological instrument manufacturers, with a large demand for professionals in automatic weather stations and radar equipment debugging and maintenance posts. However, the working environment is relatively difficult, requiring frequent business trips and even frequent visits to difficult areas such as plateaus and islands for meteorological equipment debugging and maintenance. These professionals need to have good physical fitness and a spirit of hard work.

### ***3.2 The Mismatch Between Professional Quality and the Demand for Industry and Enterprise Posts in Intelligent Upgrading***

The intelligent development of meteorological technology under information technology has brought about the upgrading and iteration of traditional meteorological industry service models. To keep up with the times in professional cultivation, it is necessary to solve the problems of mismatch, disconnection, and incompatibility between professional quality and the upgrading of post service models. At present, new service processes and post skills have not been included in the training program for meteorological professionals in vocational education.

### ***3.3 The Shortage of High-level Composite Meteorological Professionals Under New Business Forms***

Commercial meteorological services will present new business forms and the application of meteorological data is not limited to agriculture, animal husbandry, finance, insurance, clothing

manufacturers, etc., all of which require accurate meteorological forecasting. The commercial value of meteorology is constantly being explored, giving rise to many emerging meteorological industries. The market requires more innovative and entrepreneurial meteorological professionals, extends service fields and innovates service products to meet the constantly upgrading market demands. However, the current professions of major catalogue fail to cover the constantly emerging professions.

#### **4. THE DOCKING BETWEEN THE REVISION OF THE CATALOGUE OF METEOROLOGICAL MAJORS AND THE METEOROLOGICAL INDUSTRY CHAIN**

##### ***4.1 Conducting Thorough Research on the Meteorological Industry Chain to Ensure That Professional Transformation Corresponds to the Post Group in the Industry Chain***

In the early stage of this survey, comprehensive research has been conducted on meteorological industry enterprises and the meteorological industry chain. The upstream and downstream relationship of the meteorological industry chain has been investigated and clarified, and the service models, post settings, products and services of different meteorological industry enterprises, as well as the panoramic view of the meteorological industry chain have been understood.

During the summer vacation of 2020, Lanzhou Resources & Environment Voc-Tech University and Jiang Xi Vocational & Technical College of Information Application conducted comprehensive on-site research on meteorological industry enterprises, technology service companies, training institutions and colleges, and equipment manufacturers based on preliminary research. More than 80 units have been surveyed. Relevant personnel have gained a comprehensive understanding of the new technologies, business models, business forms, and professions of enterprises in the meteorological industry. They have conducted in-depth research on the post settings, post competency requirements, and post requirements of different meteorological industry enterprises. They have also conducted thorough research on the development trends of modern meteorological services, cutting-edge intelligent

meteorological technologies, the rise of commercial meteorological services, and the future market size.

The major transformation based on comprehensive research is in line with the new service models brought about by the county-level comprehensive meteorological service reform of the national meteorological departments, integrated with the constantly emerging new technologies in the intelligent transformation and upgrading of the meteorological industry, and also connected with the new professions generated by the development of China's commercial meteorological service industry, which basically covers all professional posts in the meteorological field.

##### ***4.2 The Layout for Future Intelligent Meteorological Technology Upgrading and Industrial Development, with Strong Foresight in Professional Transformation***

Referring to planning reports such as the Main Points of the 14th Five-Year Plan for National Meteorological Development, the Development Plan for Meteorological Informatization (2018-2022), and the National Meteorological Modernization Development Outline (2015-2030), and based on the trend of intelligent meteorological technology development and the new profession changes caused by meteorological industry upgrading, it is recommended to focus on future technological changes and service orientation, especially the newly added undergraduate-level majors of "Intelligent Meteorological Technology", which can reserve professionals for the development of the meteorological industry in the next 5 to 10 years, and this major transformation also has foresight.

##### ***4.3 Revising the Catalogue to Cover the Requirements for New Business Forms, Professions, and Posts in the Current Meteorological Industry***

After the reform of county-level comprehensive meteorological services, grassroots meteorological stations have a great demand for composite technical and skilled professionals, and new posts such as "county-level comprehensive meteorological service posts" have been added in vocational colleges. Since the automation of meteorological observation service, there has been a high demand for intelligent meteorological instrument and equipment installation and

maintenance personnel. The newly added professional positions in this revision include meteorological instrument debugging engineer, maintenance engineer, and other posts. The rapid development of intelligent meteorological services has led to a high demand for high-level and composite intelligent meteorological service technical and skilled personnel. The newly added undergraduate intelligent meteorological technology major includes posts such as meteorological data analyst and meteorological software development engineer.

## 5. CONCLUSION

The revision of the catalogue of meteorological vocational education majors this time is based on a thorough investigation of the meteorological industry chain and the study of relevant documents such as the 14th Five-Year Plan and the 2035 long-term goals. In the current context of intelligent upgrading of the meteorological industry and the continuous emergence of new business forms, technologies, and professions, the current catalogue of meteorological majors can no longer meet the market demand for highly skilled professionals. This revision of the catalogue can optimize the quality, specifications, and structure of meteorological professional supply, reflect industry docking, major upgrading, and digital transformation, focus on future technological changes and service orientation, and solve the current contradiction between supply and demand of meteorological professionals, which is forward-looking and can play a leading role in the cultivation of meteorological professionals in China's vocational education.

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