

# Intelligent Manufacturing Plus leads case resources and platform construction

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**How to cite this paper:** Xi, W. K., Feng, Y. Z., Guo, L. L., & Yu, Y. (2025). Intelligent Manufacturing Plus leads case resources and platform construction. *International Journal of Educational Development*, 1(2), 50–54. ISSN Print: 3104-4263; ISSN Online: 3104-4271.

<https://doi.org/10.63313/IJED.9016>

Published: 2025-09-15

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## Abstract

This paper is guided by the newest technological progress of Intelligent Manufacturing Plus, on the basis of curriculum research and current situation analysis, the AD theory is introduced into the top-level design of postgraduate courses, and the teaching process and key links are unified organized and planned. With the goal of improving the scientific research and innovation ability of graduate students, the latest technological achievements of high-quality scientific research projects such as design and manufacture of petroleum intelligent orientation sensor, development of intelligent geosteering tool while drilling, design and manufacture of intelligent underground drainage and gas recovery device, multi-physical intelligent monitoring system for petroleum equipment, multi-physical quantity monitoring of marine self-lifting platforms are introduced into the course construction, and the case construction of the Intelligent Manufacturing Plus course with petroleum characteristics was completed.

## Keywords

Intelligent Manufacturing Plus; Case teaching; Teaching reform; Scientific research innovation

## 1. Introduction

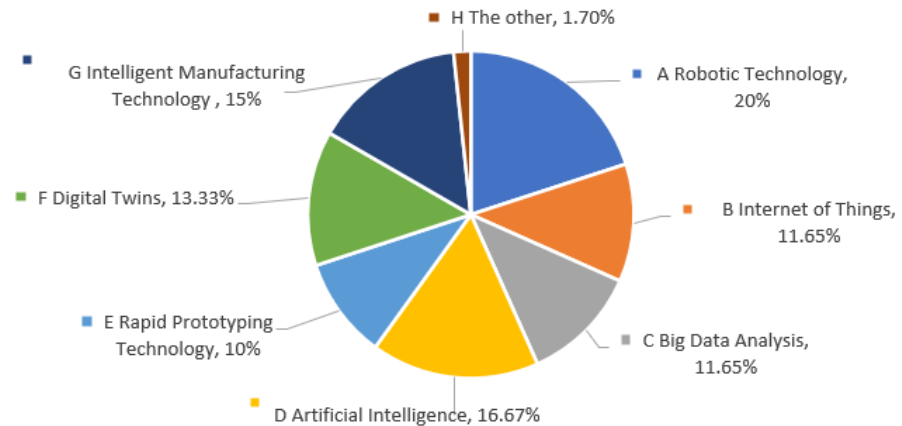
Intelligent manufacturing is the product of the deep integration of advanced manufacturing technology and the new generation of information technology[1]. It has the characteristics of digitization, networking and intelligence[2]. The cultivation of graduate students related to intelligent manufacturing plays an irreplaceable role in the new round of industrial revolution and economic development[3]. Under the background of Intelligent Manufacturing and Industry 4.0[4], in 2020 the Ministry of Education of China Several opinions on promoting discipline integration and accelerating postgraduate training in the field of artificial intelligence in double first-class construction universities proposed Construct a equal weigh training system that emphasizes both basic theoretical talents and Intelligent Manufacturing

Plus X compound talents, and moderately expand the scale of postgraduate training[5] . As a big manufacturing country, China is facing a new round of industrial revolution and international competition. The release of the State Council 's Made in China 2025 action agenda, and the release of 14th Five-Year Intelligent Manufacturing Development Plan and Guide to the construction of national intelligent manufacturing standard system ( 2024 edition ) have listed intelligent manufacturing as an important direction for the deep integration of industrialization and informatization.

This paper is guided by the latest technological progress of Intelligent Manufacturing Plus[6-7] and introduces AD theory into the top-level design of postgraduate courses, aiming at improving the scientific research and innovation ability of postgraduates and completes the case construction of Intelligent Manufacturing Plus course with petroleum characteristics. It provides reference for improving the teaching quality of the course and improving the scientific research and innovation practice ability of postgraduates, and provides help for subject research, innovation and entrepreneurship, enterprise practice and employment in related industries in the process of postgraduate training in our school.

## **2. A questionnaire survey on the training needs of intelligent manufacturing talents**

The current situation of the course is analyzed by means of teaching quality analysis and questionnaire survey and according to the requirements of relevant documents such as the Ministry of Education and schools, in-depth field investigation of the latest technological progress related to intelligent manufacturing was conducted. The on-site investigation and employment demand feedback of petroleum equipment manufacturing representative enterprises such as PetroChina Changqing Oilfield Company and CNPC Baoji Oilfield Machinery Co., Ltd. , need further optimize the training objectives of curriculum talents and the requirements of knowledge, ability and quality , and optimize the knowledge system of the curriculum. According to the results of the questionnaire survey in Fig.1, the curriculum knowledge system is further expanded and updated. On the basis of ensuring that students master the basic principles, technologies and concepts of intelligent manufacturing, they further master the application and development of the latest technologies such as Robotics, Digital Twin, Rapid Prototyping Technology, Industrial Internet of Things Plus, Artificial Intelligence and so on.

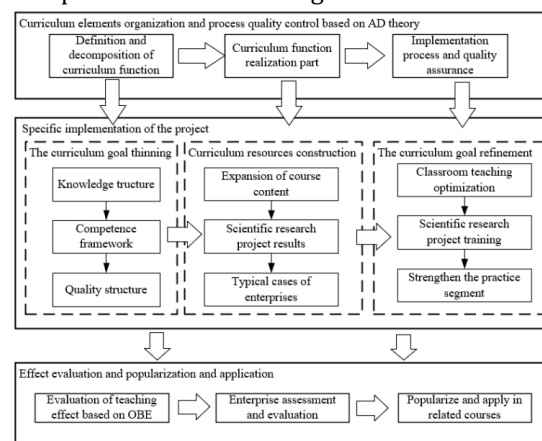


**Fig 1.** Intelligent manufacturing questionnaire survey results

### 3. Curriculum elements organization and quality control based on AD theory

Based on AD(axiomatic design) theory and related modeling methods and modeling tools, on the basis of the current situation of the course, the teaching effect and the analysis of the problems:

1)The teaching objectives of the postgraduate course of Intelligent Manufacturing Technology and Equipment are defined and decomposed. 2) The relevant curriculum elements on which the realization of multi-objectives of curriculum teaching depends are correspondingly refined and decomposed, and the corresponding construction measures and methods are given. 3) Using axiomatic process modeling and quality control methods, the quality control and evaluation of the teaching implementation process are carried out, including the organization of the teaching elements of the main teaching process and joint links, the evaluation of teaching quality and effect. From the process quality control level, it ensures the optimization and quality assurance of the teaching implementation process. The specific implementation process is shown in Fig.2.



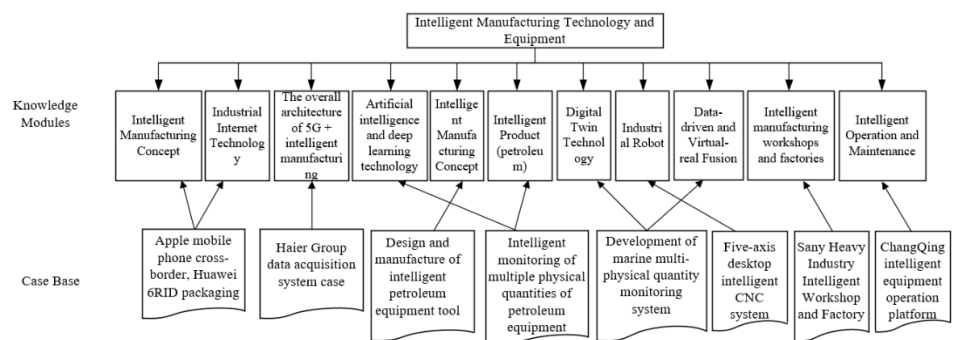
**Fig 2.** The structural design of supporting back mechanism

#### 4. Project-driven petroleum characteristic intelligent manufacturing case resources and platform construction

The latest technological achievements of related high-quality scientific research projects, such as design and manufacture of petroleum intelligent azimuth sensor, development of intelligent geosteering tool while drilling, design and manufacture of intelligent underground drainage and gas recovery device, intelligent monitoring system of multi-physical quantity of petroleum equipment, multi-physical quantity monitoring of marine lifting platform, are introduced into the course construction to create Intelligent Manufacturing Plus case resources with petroleum characteristics. Through project-driven scientific research cases are introduced into the classroom to promote the cultivation of students scientific research and innovation ability. To cope with complex intelligent manufacturing challenges.

#### 5. The construction of Intelligent Manufacturing leading course case base

Based on the teaching objectives, knowledge points and case design principles of the intelligent manufacturing course, the research group designed seven comprehensive engineering cases, and introduced Siemens digital twin intelligent system, Sany heavy industry intelligent manufacturing workshop, Changqing intelligent equipment management platform and other application demonstrations. The latest technical achievements of high-quality scientific research projects such as design and manufacture of petroleum intelligent orientation sensor, development of intelligent geosteering tool while drilling, design and manufacture of intelligent underground drainage and gas recovery device, intelligent monitoring system of multi-physical quantity of petroleum equipment, multi-physical quantity monitoring of marine self-lifting platform are introduced into the course construction, and the supporting relationship between Intelligent Manufacturing Plus case resource case library and knowledge point module with petroleum characteristics of our school is shown in Fig.3.



**Fig 3.** Construction of intelligent manufacturing course case base

## 6. Conclusion

Under the background of intelligent manufacturing, industry 4.0, China manufacturing 2025 related industries and industrial development, according to the relevant requirements of the relevant documents of the Ministry of Education on the cultivation of Intelligent Manufacturing Plus postgraduates, based on the current situation of the school, from the determination of curriculum objectives, the innovation and improvement of curriculum teaching content, the construction of curriculum advantage resources and case base, and the practical teaching of school-enterprise cooperation, the curriculum resources construction and teaching reform of the postgraduate course of Intelligent manufacturing equipment and technology, the dominant discipline of mechanical engineering in our school, are carried out. In order to provide reference for improving the teaching quality of the course and improving the scientific research and innovative practice ability of postgraduates, so as to meet the training needs of Intelligent Manufacturing Plus professional compound talents in petroleum equipment and related industries, and to provide help for subject research, innovation and entrepreneurship, enterprise practice and employment in related industries in the process of postgraduate training of machinery and related majors in our school.

## Acknowledgements

Postgraduate comprehensive education and teaching reform project of Xi'an Petroleum University, No.2023-X-YJG-011

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