

Exploration of the Path to Establishing a Professional Community in Ceramic Intelligent Manufacturing from the Perspective of Industry-Education Integration

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Abstract: With the progress of society, the level of mechanical intelligent manufacturing is progressively improving, leading to a paradigm shift in the ceramic industry from the traditional manual workshops to mechanized automation. Increasing automation of each stage of ceramic production is crucial to achieve intelligent ceramic manufacturing. However, the mechanism and automation of each stage require related courses. Systematic integration of these courses is essential to promote the development of an entire professional community. For vocational colleges, implementing educational strategies that align with the integration of industry and education is crucial. By leveraging deep collaboration between schools and enterprises, vocational colleges can create a harmonious learning environment that reflect the industrial production environment, allowing students to gain hands-on experiences during their academic tenure. The ultimate goal is to immerse students in real-world industrial practices, thus reinforcing the development of the professional community in ceramic intelligent manufacturing. In this study, we focus primarily on exploring practical approaches to interlink various courses, ultimately reinforcing the development of the Professional Community in Ceramic Intelligent Manufacturing.

Keywords: Industry-education Integration; Professional Community; Ceramic Intelligent Manufacturing; School-enterprise Collaboration; Interdisciplinary Combinations

1. Introduction

1.1 Background on the Development of the Professional Community in Ceramic

Intelligent Manufacturing

The increasing demand for intelligent manufacturing talents in the ceramic industry has made it necessary to interconnect the technologies required for various stages of ceramic production. To meet these demands, related courses are fundamental for the mechanization and automation of each stage. To create a cohesive whole, those courses need to be systematically integrated, ultimately leading to the formation of the professional community in ceramic intelligent manufacturing. The professional community comprises majors such as Ceramic Manufacturing Technology and Process, Ceramic Design and Technique, Industrial Design, Additive Manufacturing Technology, and others[1]. The goal is to cultivate professional talents with advanced intelligent manufacturing techniques and drive the transformation and upgrading of the ceramic industry. The advancement of science and technology has brought significant changes to the ceramic industry, and traditional production methods can no longer meet modern business requirements. It has become essential to introduce intelligent manufacturing technology to achieve automation, informatization, and intelligence, thereby increasing production efficiency and product quality. Smart manufacturing technology is an important direction for development in the ceramic industry, which incorporates advanced information technology, Internet of Things technology, artificial intelligence, and other technologies into the production process to achieve intelligent, autonomous, and collaborative production. The application of intelligent manufacturing technology can improve production efficiency, reduce costs, and improve product quality, providing vital support for business transformation and upgrading. With the transformation and upgrading of the ceramic industry, there is an increasing need for

professional talents with intelligent manufacturing technology. This type of talent requires knowledge of machinery, electronics, computers, ceramic manufacturing, as well as innovative thinking and strong practical abilities. To meet the developmental needs of the ceramic industry, the development of the Professional Community in Ceramic Intelligent Manufacturing is essential. Industry-education integration should be leveraged to create a harmonious learning environment that mirrors the industrial production environment. This environment allows students to gain hands-on experiences during their academic tenure, thereby immersing themselves in real-world industrial practices and reinforcing the development of the Professional Community in Ceramic Intelligent Manufacturing. The construction of this professional community is of significant importance in promoting the transformation and upgrading of the ceramic industry, increasing production efficiency, and product quality [2].

1.2 Research Objectives and Significance

By utilizing school-enterprise cooperation and industry-education integration, it is possible to effectively integrate the education resources of enterprises and schools. This integration allows students to gain exposure to more practical cases, practical experience, and professional skills during the learning process, which can improve the quality of teaching and cultivate high-quality ceramic intelligent manufacturing talents. Additionally, it promotes the cooperation between schools and enterprises, realizing the integration of production, teaching, and research. By promoting the integration of production, teaching, and research, improving the quality of teaching, and cultivating high-quality ceramic intelligent manufacturing talents, we can better drive technological innovation in ceramic production and cultural inheritance, promote the development of the ceramic industry, and facilitate the inheritance of ceramic culture. These measures can further drive technological innovation and development in the ceramic industry, ultimately contributing to its continued growth [3].

2. Paths for the Development of the Professional Community in Ceramic Intelligent Manufacturing

2.1 Development Goals and Strategies for Professional Community in Ceramic Intelligent Manufacturing

The goal of developing the professional community in ceramic intelligent manufacturing is to cultivate high-skilled ceramic manufacturing talents and improve the level of the ceramic industry. This can be achieved by optimizing the curriculum and teaching resources, improving the quality of education, and cultivating ceramic manufacturing talents with high-level professional skills to meet the industry's demand for high-skilled personnel. To promote the digital and intelligent transformation of the ceramic industry, the professional community will work towards deep collaboration between schools, enterprises, and industry associations to develop intelligent manufacturing centers, industrial internet platforms, and other means. This will help improve production efficiency, reduce costs, and enhance product quality. The professional community also aims to achieve deep integration between the education and industry chains and jointly promote the development of the ceramic industry. To ensure that the professional community adapts to the needs of the industry, it will closely monitor the latest trends and demands of the ceramic industry and make timely adjustments and optimizations to the curriculum accordingly. High-quality resources from schools, enterprises, and industry associations will be effectively integrated to jointly participate in the development of the professional community in ceramic intelligent manufacturing. Innovative teaching methods, such as project-based learning and scenario-based learning, will also be employed to stimulate students' interests and potential and improve the effectiveness of education [4]. In addition, the professional community will strengthen the construction of the teaching staff by introducing and cultivating excellent teachers to establish a high-quality teaching team that can provide strong support for the development of the professional community. The professional community aims to deepen cooperation between schools and enterprises by jointly conducting teaching, research, and production activities to achieve mutual benefit and win-win results. It will also strengthen international cooperation and exchanges by actively participating in international cooperation and exchanges, introducing advanced vocational education

concepts and resources from abroad, and promoting the international development of the professional community in ceramic intelligent manufacturing. To achieve the development of the professional community, it is necessary to integrate high-quality resources from multiple sources, innovate teaching methods, strengthen the construction of the teaching staff, deepen cooperation between schools and enterprises, and actively engage in international cooperation and exchanges. These measures can effectively improve the teaching quality and competitiveness of the Professional Community in Ceramic Intelligent Manufacturing and provide strong support for the development of the ceramic industry.

2.2 Contents and Measures for Developing the Professional Community

To develop the professional community in ceramic intelligent manufacturing, the following measures will be implemented: (1) Optimization of talent cultivation programs: A talent cultivation plan that meets the needs of the ceramic intelligent manufacturing industry will be developed, emphasizing the combination of theoretical knowledge and practical skills, as well as innovation ability and professional ethics. (2) Construction of a complete curriculum system: A curriculum system consisting of basic courses, specialized courses, practical courses, and innovation and entrepreneurship courses will be established, with a focus on updating and optimizing course content. Advanced and cutting-edge technologies and the latest research results from the industry will be introduced to improve the practical and forward-looking nature of the curriculum. (3) Strengthening practical teaching system: A complete system for school-based and off-campus practical training bases will be established, and practical teaching content will be targeted towards practicality and effectiveness. The teaching mode of combining theory with practice will be adopted to enhance students' practical and innovation ability. (4) Construction of a high-quality teaching staff: Teachers with industry background and rich practical experience will be introduced, and they will be encouraged to participate in industry training and academic exchange activities to improve their professional quality and teaching level. (5) Deep integration with enterprises: Cooperation with enterprises will be strengthened to jointly develop courses, develop

teaching materials, and implement teaching. A deeper cooperation relationship with enterprises will be established to achieve resource sharing and complementary advantages. (6) Establishment of a sound quality monitoring and evaluation system: The whole process of talent cultivation will be monitored and evaluated, problems will be timely discovered and measures taken for improvement, to ensure the quality and effectiveness of talent cultivation [5]. (7) Uplift of technical service and research and development capabilities: Active scientific research projects and technical services will be carried out to promote the transformation and application of research results, enhance the school's reputation and influence. (8) Actively participating in the construction of ceramic intelligent manufacturing industry standards and norms: cooperation with industry associations, standardization organizations, and other related professional qualification certification institutions will be established to jointly develop relevant industry standards and norms and promote the healthy development of the ceramic intelligent manufacturing industry. (9) Strengthening international exchanges and cooperation in the field of ceramic intelligent manufacturing: advanced concepts and technologies from abroad will be introduced to promote the innovation and development of the ceramic intelligent manufacturing industry in China. (10) Improving the social service capabilities: Technical support and services will be provided to the industry and enterprises through various activities such as technical consulting, technical training, and technical services to promote technological progress and development in the industry.

The development of the professional community in ceramic intelligent manufacturing is a comprehensive and systematic project that requires comprehensive planning and implementation in multiple areas, including talent cultivation programs, curriculum systems, practical teaching systems, teaching staff, school-enterprise cooperation, quality monitoring and evaluation, and technology services and research and development. Only in this way can the industry's ongoing development and market demands be better catered to, and only then can high-quality and highly skilled ceramic intelligent manufacturing talents be cultivated to promote the rapid development of the ceramic intelligent manufacturing industry in

China.

2.3 Development Path and Methods

To develop the professional community in ceramic intelligent manufacturing, specific goals, including improving the quality of talent cultivation, promoting industry upgrading and transformation, and enhancing the core competitiveness of enterprises, must be clearly defined. Based on these goals, a concrete development plan should be formulated, including curriculum design, teaching staff development, practical teaching, and scientific research and innovation. To improve the overall quality and level of the teaching staff, outstanding teachers should be introduced and trained. Teachers should be encouraged to participate in industry practices and research to enhance their practical abilities and academic level. In combination with industrial demands and industry development, curriculum design should be optimized, with emphasis on combining theory and practice, highlighting the cultivation of students' practical operational and innovative abilities. By establishing practical teaching bases and promoting school-enterprise cooperation, emphasis should be placed on strengthening practical teaching and improving students' practical skills and employability. Teachers and enterprises should be encouraged to collaborate on scientific research and innovation, promoting technological innovation and industry upgrading. Through collaboration with internationally renowned enterprises and universities, advanced ceramic intelligent manufacturing technologies and experiences can be introduced, advancing China's internationalization of the ceramic industry. A scientific evaluation system should be established to assess the process and achievements of the development of the professional community in ceramic intelligent manufacturing, finding problems and making improvements in a timely manner. By deepening the integration of industry and education, school education and enterprise cooperation should be deeply integrated with industry and enterprises. Cooperative efforts should be made to develop teaching materials and practical teaching workbooks based on enterprise production reality. Activities such as shared technology research and development and product innovation need to be jointly pursued to advance the development of the ceramic industry.

Information technology should be integrated into the development of the professional community in ceramic intelligent manufacturing, using technologies like digital design and intelligent manufacturing to improve the quality and production efficiency of ceramic products. Information technology can also be utilized for remote education, online learning and other activities to expand students' learning channels and spaces [6]. Participation in the formulation of industry standards and norms can promote the normalization and standardization of the ceramic industry. Attention should be paid to industry development trends and the development plan for the professional community should be adjusted and optimized accordingly to meet industry needs. Comprehensive assessment and evaluation of the development process and results should be conducted and the development plan adjusted accordingly to ensure the effectiveness and sustainability of the professional community development.

The development of the professional community in ceramic intelligent manufacturing requires participation from multiple stakeholders and comprehensive promotion. In the specific implementation process, attention should be given to the rationality of curriculum design, the quality and abilities of the teaching staff, the quality and effectiveness of practical teaching, and the level and impact of research and innovation, while emphasizing the combination of theory and practice. Emphasis should be placed on teacher development, practical teaching, and scientific research and innovation. At the same time, international cooperation and communication should be strengthened to enhance the international competitiveness of China's ceramic industry. The development plan should be continuously adjusted and optimized to meet the needs of industry development and the personal development needs of students. Cultivating high-quality talent with innovative awareness and practical abilities will contribute to the upgrading and development of China's ceramic industry.

3. Challenges and Countermeasures in the Construction of Professional Community in Ceramic Intelligent Manufacturing from the Perspective of Industry-Education Integration

3.1 Challenges

Firstly, while there are a considerable number of advanced ceramic enterprises in China, many of them are small-scale enterprises (70% micro, small and medium-sized enterprises) with limited independent innovation capabilities and market competitiveness due to their reliance on external technology imports for their key and core technologies. This results in single-product lines and high manufacturing costs, which hinders their growth and development. Secondly, although China has various universities and research institutions that specialize in advanced ceramic research, and some have achieved remarkable results, most of their achievements require technology transfer and commercialization. Unfortunately, the conversion of these achievements into practical applications is often limited. This highlights the need to improve technology transfer mechanisms. Furthermore, there is a serious bottleneck problem in the material R&D chain, and domestic research often focuses only on material systems, preparation processes, or certain key technologies, while neglecting the basic research on related technologies and production equipment that are associated with the R&D chain. This has to some extent delayed the industrialization and application of many excellent achievements. The professional community in ceramic intelligent manufacturing needs to address the challenges mentioned above by continuously improving the enterprise's independent innovation capability, strengthening the transformation of scientific and technological achievements, enhancing basic research, and addressing the issue of declining output. At the same time, it is also crucial to pay attention to the overall development trend of the industry and improve the competitiveness of the enterprise [7].

3.2 Proposed Solutions and Suggestions

At the government level, it is essential to encourage and support ceramic enterprises to invest in technology innovation. This can include funding research and development for new products, introducing new technologies, and improving existing processes. By partnering with universities and research institutions, they can promote technological research and development and drive industry upgrades to enhance the added value of ceramic products and increase their market competitiveness. Furthermore, strengthening education and

training in ceramic manufacturing is crucial. Cooperating with universities, vocational schools, and training institutions and developing comprehensive talent development programs can provide sufficient human resources for the ceramic industry, promoting cooperation and communication between ceramic manufacturing enterprises to achieve resource sharing and complementary strengths [8]. Through establishing industry associations and alliances, communication and collaboration between enterprises can be enhanced, leading to a healthier industry ecosystem. Green production should also be promoted among ceramic manufacturing enterprises, reducing environmental impacts to meet the demand for sustainable development. Enterprises must pay close attention to market demand changes and timely adjust product structure and production direction. This can be achieved through market research and analysis to understand consumer needs and behaviors and develop products that meet market demands while increasing market share. Ceramic enterprises should also focus on brand building and promotion, increasing brand awareness and reputation. This can be achieved by showcasing the uniqueness and advantages of products through participating in international exhibitions, forums, and other activities. By actively expanding domestic and international markets and increasing sales channels, ceramic products can broaden their sales channels and establish contacts with international clients, expanding overseas markets.

The development of the professional community in ceramic intelligent manufacturing is a collective effort that requires the participation of different key stakeholders, including the government, enterprises, educational institutions, among others. These stakeholders need to come together and work collaboratively to promote the sustained development and upgrading of the industry. To achieve this, they need to focus on various aspects that are critical to the industry's growth and prosperity, including technology innovation, talent cultivation, industry collaboration, green production, market demand, brand building, and policy support. Each of these aspects is essential for driving industry growth and enabling ceramic companies to stay competitive in the market. Moreover, they need to address challenges related to market expansion, supply chain integration, quality management, innovative marketing, and

sustainable development to enable ceramic companies to improve core competitiveness and market position continually.

4. Case Study

Tongxin Ceramics is a great example of an enterprise that has placed intelligent manufacturing at the core of its operations. By incorporating advanced ceramic production lines, ceramic 3D printing technology, and automation equipment (in addition to artificial intelligence and big data), the enterprise has created a Tongxin Ceramic Intelligent Manufacturing system that is leading the world. In their pursuit to improve the quality of ceramic products, increase production efficiency, and reduce costs, Tongxin Ceramics has provided critical technical support and industry demonstrations for the global ceramic planter industry. As consumer tastes and living standards evolve, there is a growing demand for various ceramic planter styles, which has increased the need for product personalization, as well as quality standards. Traditional ceramic companies encounter numerous obstacles like rising labor costs, energy constraints, and low production efficiency, which are exacerbated by fierce domestic and international market competition. This provides a significant challenge for enterprise transformation and upgrading. Intelligent manufacturing has become an essential stratagem for transforming and reviving the ceramic industry. Automated production methods greatly improve productivity and lower production costs; these methods increase the product quality and meet increasingly stringent personalization demands. Intelligent manufacturing remedies traditional manufacturing industry challenges like a shortage of labor, high energy consumption, and low production efficiency [9].

This ceramic enterprise has implemented intelligent management throughout its entire production process, from raw material procurement to product manufacturing and sales, through the development of digital ceramic intelligent manufacturing management. Advanced ceramic production lines and automation equipment have been introduced to automate and optimize the production process. Additionally, the enterprise has leveraged artificial intelligence, big data, and other technologies to develop intelligent production management systems that support efficient,

digital, and information-oriented production. By establishing an equipment interconnection network and sharing data among the devices by means of the Industrial Internet of Things (IIoT), production efficiency and product quality are improved. Furthermore, the enterprise has established a strong research and development system, with a focus on technological innovation and product development, to promote its product and industry upgrades. Their digital and intelligent production system provides valuable lessons for the transformation and upgrading of traditional manufacturing industries. In the future, with the development of advanced technologies like artificial intelligence and big data, intelligent manufacturing will gain wider application in the ceramic industry. More work should be done to strengthen technology innovation and talent development to provide strong support for the sustainable growth of the ceramic industry [10].

5. Conclusions and Outlook

In conclusion, the ceramic intelligent manufacturing industry is a crucial component of modern manufacturing as it plays a vital role in increasing production efficiency, lowering costs, and improving product quality. The industry encompasses multiple fields like ceramic manufacturing, intelligent manufacturing, and industrial automation, contributing to the sustainable growth of the manufacturing sector. With the continuous evolution of technologies like artificial intelligence, the Industrial Internet of Things (IIoT), and big data, the ceramic intelligent manufacturing industry is actively progressing towards digitalization and intelligence. However, the industry faces certain challenges such as the fast-changing technological environment and talent shortages. Despite these challenges, the ceramic intelligent manufacturing industry offers enormous opportunities for growth and development. With the ongoing transformation and upgrading of the manufacturing industry, the ceramic intelligent manufacturing industry is destined for higher market demands and greater development opportunities.

Looking forward, the domain of ceramic intelligent manufacturing exhibits several shortcomings and areas requiring further exploration and research. The advancement of ceramic intelligent manufacturing is envisaged as a prolonged and formidable undertaking.

Continuous exploration and innovation are imperative in propelling the perpetual enhancement and progression of the ceramic industry, enhancing production efficiency, elevating product quality, shortening production cycles, promoting environmental sustainability and sustainable development, delving deeper into the application of intelligent technologies, and facilitating industrial collaborative innovation. The prospects for the development of ceramic intelligent manufacturing are vast, yet necessitate considerable dedication. Strengthening international cooperation, drawing insights from cutting-edge international practices and technologies are essential in realizing a superior echelon of intelligent manufacturing. Only through incessant problem-solving and pioneering advancements can the ceramic industry tread further along the path of intelligence.

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