



Reform and Practice of Financial Engineering Talent Cultivation Model under the Background of Financial Innovation

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Abstract. Financial engineering is a product of the trend of economic globalization, which has changed the traditional financial landscape. The implementation of financial engineering has become a credential for great powers to compete and participate in global financial activities. The development of financial engineering is inseparable from the cultivation of talents in financial engineering. This paper introduces the history of the financial engineering discipline, examines the motivations behind its emergence and development, analyzes the disciplinary characteristics of financial engineering and the concept of financial innovation. Based on an analysis of the issues in the development of China's financial engineering discipline, the paper then proposes reforms and development ideas for the talent cultivation mode of financial engineering in the context of financial innovation.

Keywords: Financial engineering, Financial Innovation, Talent cultivation model

1 Introduction

Financial engineering, as a specialized discipline, was proposed in 1990 against the backdrop of financial liberalization that swept the globe in the 1970s. During this period, financial innovation reached unprecedented heights, accompanied by escalating financial risks. This led to an explosive growth in financial derivatives, which emerged as powerful tools for managing financial risks. As a result, the traditional landscape of the financial industry underwent profound transformations [1]. The ideas of financial engineering, rooted in neoclassical finance, began to gradually sprout and take shape. They developed rapidly and emerged as the theoretical foundation and technical assurance for the continuous advancement of financial innovation and financial derivatives. In the 1990s, the ideas and methodologies of financial engineering became widely applied within the financial sector. Solutions to various financial problems increasingly exhibited engineering characteristics, marking the transition of financial disciplines from traditional descriptive and analytical stages to an engineer

ing-oriented stage. The establishment of the International Association of Financial Engineers in 1991 signaled the official birth of the discipline of financial engineering. With the foundation of this discipline, many universities abroad subsequently established the major of financial engineering and corresponding research institutions, which fueled the rapid development of the financial engineering discipline.

Financial engineering has been widely applied in various fields of finance. In the area of securities investment, financial engineering can reduce risks by constructing investment portfolios and can also utilize derivatives for hedging. In the insurance sector, financial engineering provides data support to insurance companies through actuarial science and risk assessment, aiding them in better product design and risk management. In credit evaluation, financial engineering conducts data analysis and model building based on borrowers' credit histories, financial conditions, and other factors, thus providing more accurate support for lending decisions. In the context of global economic integration, holding sovereignty in financial activities can ensure a competitive edge in global competition, and the implementation of financial engineering has become a passport for participating in global financial activities [3].

Early development of the financial industry in China was relatively closed-off, so cultivating our own financial engineering talents has become increasingly important. Due to the interdisciplinary complexity of financial engineering, universities have become the main front in cultivating such talents. China's financial engineering major was first established in the mid-1990s. Although it has not been around for long, it has developed rapidly. From five universities approved by the Ministry of Education in 2001, including Renmin University of China, Central University of Finance and Economics, Wuhan University, Southwestern University of Finance and Economics, and Xiamen University, it has grown to 282 institutions of higher learning today. A complete degree education system for financial engineering, ranging from bachelor's to doctoral degrees, has been formed [2].

The financial engineering major has become a popular choice in recent years due to its high return rates and high development ceilings. With the rapid rise of big data and artificial intelligence technologies, the traditional financial industry is undergoing transformation and re-engineering, leading to a growing demand for new types of financial talents. The engineering mindset of financial engineering and the approach to data modeling and analysis align well with the characteristics of data science. In the context of financial innovation, it is particularly important for universities offering financial engineering programs to seize the opportunities brought by technological development, actively adapt to changes in the global economic development situation, and adjust and reform their talent training models.

2 Characteristics of Financial Engineering

Financial Engineering exhibits strong interdisciplinary characteristics, encompassing a wide range of academic disciplines such as mathematics, economics, risk aversion, and data collection and statistics. The concept of Financial Engineering as a discipline was first proposed by American finance professor John Finnerty, who believed that

Financial Engineering involves the design, development, and implementation of innovative financial instruments and techniques, as well as the creative resolution of financial problems. Professor Finnerty emphasized innovation and creativity, linking Financial Engineering closely to financial innovation from its inception. Financial Engineering serves as the lifeblood of financial innovation.

In the book "Financial Engineering," Marshall and Bansal pointed out that innovation and creativity are equally important in Financial Engineering, with multiple connotations [4]. Firstly, it represents a leap in thinking within the financial domain, embodying high creativity. Secondly, it involves new interpretations and applications of existing concepts. Thirdly, it involves the recombination of existing financial products and instruments to meet specific needs. This provides a good explanation of the characteristics of Financial Engineering contained in Finnerty's concept and clarifies that as a discipline, Financial Engineering comprehensively introduces mathematical analysis, computer technology, telecommunications technology, automation, and systems engineering into the financial field. It utilizes advanced engineering techniques such as operations research, mathematical modeling, numerical computation, network diagramming, simulation technology, and artificial neurons to design and develop financial products and creatively solve various financial problems. Financial Engineering employs engineering methods such as modeling, numerical simulation, and statistical analysis to study problems, with many complex calculations and numerical simulations relying on computers. The development of the Financial Engineering discipline requires the support of information technology, which in turn drives the development of the Financial Engineering discipline.

Another important characteristic of Financial Engineering is portfolio decomposition technology, where complex financial instruments can be decomposed into a series of relatively simple ones. Pricing analysis of complex instruments can be conducted by valuing simple instruments. The application of this portfolio decomposition technology allows for the modification of the liquidity and risk characteristics of financial instruments' returns, enabling the creation of financial products tailored to meet clients' specific needs, truly customizing solutions for them. The above analysis reflects that the construction of financial engineering disciplines should be based on financial economics, supported by engineering methods and information technology, and provide innovative services for the development of capital markets, financial intermediaries and corporate finance.

3 The Motivation Analysis of the Development of Financial Engineering Discipline

The emergence and development of financial engineering is the result of the interaction of internal and external factors. From the external point of view, the emergence of financial engineering is the inevitable product of the development of global economic integration. The development of capital market globalization has caused the collapse of the fixed exchange rate system. The fluctuation of exchange rate has a great impact on interest rate, enterprise financial cost and product price. The market

competition is becoming increasingly fierce, and the increasing financial risk forces financial institutions and enterprises to formulate new business strategies through various innovative activities to adapt to the changes in the market environment, which has led to the emergence of financial engineering. The development of science and technology is also one of the important external factors. The rapid development of information technology, network communication and artificial intelligence provides strong technical support for the development and research of financial instruments [5]. The formation and development of modern financial theory, such as no-arbitrage equilibrium analysis, capital asset pricing, option pricing, incomplete asset market general equilibrium theory, has also laid a theoretical foundation for the development of financial engineering as an important external cause.

The internal cause mainly comes from the high cross-integration characteristics of the financial engineering discipline itself. Financial engineering organically integrates multi-disciplinary knowledge such as finance, engineering technology and information technology, and creatively provides solutions to financial problems of financial institutions or enterprises, so as to better avoid financial risks and improve investors' income. Financial institutions and enterprises can provide great benefits for the development of financial engineering.

4 Financial Engineering and Financial Innovation

From the beginning of the emergence of financial engineering, it has the characteristics of innovation and creation. With the rapid development of science and technology, financial innovation and creation also increasingly reflect the nature of science and technology. The wide application of big data, cloud computing, artificial intelligence, blockchain and other technologies in the financial industry has added scientific and technological characteristics to financial innovation and creation. According to the definition of the International Financial Stability Board (FSB), financial technology refers to the financial innovation brought by science and technology [7].

With the help of big data, we can target customer data from massive financial data, facilitate financial institutions to achieve precision marketing, and improve the efficiency of financial activities. In addition, through big data analysis, a scientific financial scoring system can be established to improve the management level of risk early warning. Cloud computing can flexibly configure the source of the network to meet the needs of financial business, avoid waste of resources, improve processing efficiency and reduce operating costs. At the same time, it can realize the centralized storage, management and maintenance of financial data resources, and maximize the utilization and efficiency of resources. Through face recognition, language recognition, touch perception and other technologies, Artificial Intelligence (AI) can quickly read customers' personal information and provide customers with faster and more accurate services. At the same time, the application of machine learning technology can make AI constantly adjust the trading strategy like human beings in continuous learning and trial and error, and manage risks more effectively. In the financial business, the application of blockchain technology, with the help of password encryption

and distributed accounting, to achieve point-to-point network structure, distributed system architecture, decentralized storage mode, to ensure the security of transaction records, to maximize the protection of the legitimate rights and interests of traders

The scientific and technological innovation of financial innovation makes the training of financial engineering professionals face both opportunities and challenges [9]. In the context of rapidly evolving technology and market competition, traditional academic disciplines are being redefined by internet thinking and innovative information processing methods. Despite this, financial engineering education faces significant challenges, primarily in enhancing faculty literacy to meet the demands of modern education. Teachers need to adapt to the network teaching mode and have the innovation ability of combining network and teaching, which can provide targeted solutions for the learning needs of professional students. Secondly, in the reform of education and teaching, it is necessary to innovate teaching, teaching reform, and the reform of talent training methods. To achieve structured and unstructured data adjustment, it is necessary to analyze and process based on existing data, but not completely rely on data.

5 Analysis on the Development of Financial Engineering Discipline in China

After continuous development, China 's financial engineering program has become increasingly large. At present, nearly 300 colleges and universities have set up financial engineering specialty. Even if they do not set up this specialty, they also include financial engineering related courses into the curriculum system of financial related specialty. However, due to the late start of China 's financial engineering discipline, there is still a certain gap compared with economically developed countries [6]. In terms of theory and concrete practice, China 's financial engineering specialty needs to be improved and developed, which is manifested in the following aspects.

5.1 There is a Need for a Unified Understanding of the Discipline of Financial Engineering

Based on the analysis of the internal and external factors contributing to the emergence and development of the financial engineering discipline, it is evident that financial engineering is a product of the trend of global economic integration. Due to its interdisciplinary nature, financial engineering cannot be developed in isolation from other disciplines. When establishing financial engineering programs, many universities design their curriculum systems based on their own professional strengths, leading to the formation of different development directions for the financial engineering discipline. Some universities believe that financial engineering should emphasize the mastery of mathematical and scientific knowledge, leveraging their immediate professional strengths and categorizing financial engineering under the scope of science. Other universities consider financial engineering as a research direction of finance and argue that it should not be separated from the economic scope of finance, thus

classifying it under economics. Still, some universities propose that financial engineering should be categorized under management to align with MBA education. The inconsistency in understanding the discipline has resulted in diverse classifications of financial engineering. The different classifications of the discipline have led to significant variations in the talent training objectives and methods among universities, hindering the coordinated development of the discipline..

5.2 The Discipline Lacks Leading Scholars, and the Professional Teaching Staff Needs to be Improved

Most of the mid-to-high-level talents in China's financial industry have backgrounds in liberal arts, with strong foundations in economic and financial theories but relatively weak foundations in mathematics and science. Therefore, it is relatively difficult for them to understand and grasp financial engineering, which is highly interdisciplinary with mathematics and science. In contrast, financial engineering researchers with backgrounds in science and engineering have strong mathematical foundations but often lack support from economic and financial theories. Consequently, their research on financial engineering tends to be disconnected from practical financial issues, resulting in low applied value. These problems arise from the professional barriers of traditional disciplines. Breaking these barriers, deepening the cultivation of interdisciplinary talents, and nurturing more leaders in financial engineering will be a long-term task. In terms of teaching financial engineering, due to the high interdisciplinarity of the subject, there are high requirements for professional teachers. They must possess multidisciplinary educational backgrounds and strong comprehensive knowledge systems, as well as certain financial practice experience. Currently, such professionals are relatively scarce in universities.

5.3 The Software and Hardware Resources for Financial Engineering Need to be Enhanced

Financial engineering is the application of financial science. Through extensive practice, students need to understand the design, development, and implementation of financial instruments, as well as the financial design involved in mergers, acquisitions, and restructurings. This discipline aims to directly address financing and investment decisions, assess the rationality of prices and costs, and identify and solve new problems. To meet these requirements, it is necessary to establish financial engineering laboratories equipped with professional software resources for practical training of students. However, the current experimental environment in universities is still dominated by computers, and due to the lack of complete hardware facilities, the ability to promptly receive and process transaction-related data is limited [8]. Because of course scheduling and experimental conditions, many course experiments cannot be conducted during normal market trading hours. This leads to students having a weaker sense of the financial market environment, lacking a deep sense of learning, and the experimental effect cannot be guaranteed.

5.4 The Updating Speed of Teaching Content is Slow, and it Lacks Localization Characteristics

In the process of developing China's financial engineering discipline, there has been considerable borrowing of experience from abroad, and a large number of foreign textbooks have been introduced. Most domestically compiled textbooks also reference foreign textbooks. However, for the financial engineering discipline, the financial issues studied are closely related to politics and ideology, and many theories are premised on economic policies and financial regulations. Due to significant institutional differences, many foreign textbooks contain cases that are not compatible with China's national conditions and lack reference value. For example, concepts such as the Efficient Market Hypothesis, Portfolio Theory, Capital Asset Pricing Model, and No-Arbitrage Theory in financial engineering cannot be fully applied in China and require extensive empirical research and corresponding adjustments. To address these issues, apart from borrowing from textbooks with mature and well-developed theoretical systems, more attention should be paid to the localization of teaching content and cases.

6 Reform Ideas for the Cultivation Mode of Talents in Financial Engineering

By introducing the development history of the financial engineering discipline and analyzing its characteristics, this discussion highlights the close connection between financial innovation and the financial engineering discipline. Based on an analysis of the issues facing the development of financial engineering programs in Chinese universities, in order to promote the development of the financial engineering discipline in China, it is necessary to reconstruct and optimize the cultivation system for financial engineering majors. This will enhance the quality of talent cultivation, fostering more high-quality financial talents who can adapt to market changes, are familiar with the operational mechanisms of financial markets and the processes of financial business operations, understand the working principles of cutting-edge technologies and their applications in the financial field, possess practical abilities and innovative consciousness, and can better serve socio-economic development [10].

6.1 Conduct Scientific Analysis of the Current Situation and Formulate Reasonable Training Programs

Financial services have shifted from traditional, rigid, and passive service models to new financial services that actively align with technological innovations. This transformation has led to a landscape where financial transactions by market entities become more standardized and financial services provided by financial institutions tend to be more refined. However, traditional financial talent cultivation focuses excessively on the imparting of financial theoretical knowledge, neglecting the cultivation of professional skills and lacking a grasp of professional frontiers. Additionally, the

updating speed of knowledge systems is slow. This relatively rigid cultivation mechanism can easily lead to deviations between professional knowledge and industry development as well as market demands, making it unable to adapt to various demands driven by market changes.

The traditional cultivation of financial engineering talents features a relatively homogeneous and undifferentiated approach, hindering students' personalized development and neglecting the cultivation of their learning initiative and innovative spirit. The demand for new financial talents in society is not only for those with basic knowledge of financial majors but also for those who are familiar with the development laws of the high-tech industry and can grasp the market operation trajectory and development trends of finance and the high-tech industry. A single cultivation mode cannot meet such requirements. The existing education mode is somewhat deficient in cultivating students' practical abilities, preferring to impart theoretical knowledge. The teaching method lacking support from specific cases and practical teaching can easily lead to an extension of the talent cultivation cycle and increased costs for employers, failing to meet the talent needs of enterprises.

Based on the above reasons, when formulating cultivation programs and setting cultivation goals, the main focus should be on aligning talent cultivation with social needs and constructing differentiated cultivation modes. Based on the Outcome-Based Education (OBE) concept, the principle of reverse design and forward implementation should be followed to design talent cultivation programs. Meanwhile, an open financial talent cultivation mode should be constructed to achieve collaborative education among multiple parties [11]. Following the logic of market operation and paying equal attention to theory and practice, an interdisciplinary knowledge system for financial talent cultivation should be established.

6.2 Strengthen the Construction of a Practical Teaching System and Establish a Multi-party Collaborative Financial Talent Training Model

Further strengthening the construction of experimental teaching, and vigorously improving hardware and software facilities, can facilitate the realization of simulated trading and analysis of stocks, bonds, futures, options, foreign exchange, and other financial instruments. At the same time, an experimental platform should be established to mine and organize financial data, providing a basic environment for teachers' teaching and convenient conditions for students' learning. Strengthening experimental teaching simulated by modern computer technology can cultivate students' practical and innovative abilities. Establishing various practical teaching resources and constructing an open financial talent training model can achieve collaborative education among multiple parties. Actively introduce experts, senior executives, or technicians from the financial industry to undertake part of the practical teaching work, while also assigning teachers to relevant enterprises for on-the-job training and learning, so that teachers can acquire the latest knowledge and skills in practical work.

Shift from closed teaching to open teaching to enhance students' innovative design capabilities. Transform the teaching-centered approach to a learning-centered one, with students as the main body. Reform the teaching process and teaching methods,

and cultivate students' active learning abilities, problem-analyzing abilities, and problem-solving abilities through practical teaching, case teaching, and heuristic teaching. Actively encourage students to participate in various financial competitions such as financial modeling, investment simulations, and market research to cultivate their teamwork awareness and data processing and analysis abilities, and enhance their proactive innovation awareness and practical abilities. At the same time, actively invite industry experts to hold special reports for students, allowing students to engage in close contact with industry experts to deepen their understanding of industry rules and financial development trends.

6.3 Strengthen the Development of Curriculum and Teaching Resources, and Actively Promote the Reform of Teaching Methods

Accelerate the updating of the knowledge system and integrate the latest advancements in financial theory and practice into the teaching of financial engineering through new knowledge carriers. Strengthen the instruction of data science knowledge, focusing on cultivating students' abilities in data analysis and visualization, Python programming, big data, artificial intelligence, and other cutting-edge technologies. Reinforce the learning of interdisciplinary knowledge that intersects with financial engineering, such as statistics and computer science, and collaborate with enterprises to offer specialized and expanded courses for differentiated training. Strengthen professional skills and comprehensive qualities, broaden the international horizons of financial engineering professionals, and guide students to pay attention to and discuss international financial hot topics in curriculum design and teaching content to enhance their learning interest and critical thinking abilities.

Encourage teachers to teach students in accordance with their aptitudes to make the teaching content more relevant to students' needs. Actively engage in teaching research, encourage teachers to utilize information technology to change traditional classroom teaching models, and actively promote case-based teaching. Highlight practical teaching sessions in the teaching plan, emphasizing the cultivation and training of students' practical skills. Invite industry experts to participate in discipline construction and teaching, and allow students to engage in teachers' research projects as early as possible, so that they can receive thinking and expansion training while completing project research. Encourage students to selectively obtain high-value certificates related to their professional directions and job positions.

6.4 Strengthen the Construction of the Teaching Staff for Financial Engineering

Strengthen the recruitment of high-level talents, actively encourage teachers to pursue doctoral degrees while in service, continuously improve teachers' practical teaching abilities, establish a two-way flow mechanism between schools and enterprises, and assign teachers to take temporary positions in enterprises for practical training. Encourage teachers to actively write papers and apply for projects to continuously enhance their research and teaching capabilities. Establish a team of double-qualified

and double-competent teachers led by professors and associate professors, with middle-aged and young teachers as the backbone, who possess rich teaching experience and strong research capabilities.

7 Conclusion

As a representative of the emerging interdisciplinary field, financial engineering has been redefined along with the trends of global economic integration and continuous technological innovation. The development of financial engineering programs in universities must clarify the characteristics of the discipline and correctly categorize it. It is essential to understand the internal and external motivations driving the development of financial engineering, carefully analyze the relationship between financial engineering and financial innovation, recognize the current issues in talent cultivation for financial engineering, and continuously adjust the talent training model. Universities should clearly define their training objectives, establish curriculum systems that are relevant to the market, innovate teaching models, and through the recruitment and training of dual-qualified teachers, ensure that the educational resources and strengths of the institutions meet the requirements for talent cultivation in the trend of digital finance.

Acknowledgments

This work is supported by the Anhui Province Higher Education Scientific Research Project (Grant Nos. 2023zygzts084, 2023AH051508 and 2023AH051512), 101 Project (2023ylyjh052), Huainan Normal University Quality Engineering Project (Grant Nos. 2023hsjyxm02, 2023hsjyxm08, 2023hsjyxm18, 2023jyxm0795, 2024hssyb03, 2024hswzy02, 2024hssjld02).

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