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MANAGEMENT OF INNOVATIVE PROCESSES IN HIGHER EDUCATION INSTITUTIONS

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ANNOTATION

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The dissertation work is a current research devoted to the issues of managing innovative processes in educational institutions to increase their competitiveness and adaptation to the requirements of the modern educational environment.

Four main theories of management were studied. Their advantages and disadvantages are determined, which consider the specifics of the activities of educational institutions in China. Hierarchy theory emphasizes differences in the division of labor at different levels of management of educational institutions. The size of the institution, the distribution of subjects and disciplines, the formation of an organizational system with effective control and coordination at lower levels should be considered when creating an innovative management system.

The theory of human capital is of great importance in the context of discussing the function of educational institutions and directions for introducing innovations into the management system. Understanding social value is an important basis for determining the function of higher education institutions. Full awareness of the differences between the needs of human capital and the dynamism of the development of economic systems determine the scale of professional development of educational institutions and the entire society. According to the theory of competitiveness, the management of educational institutions cannot copy a set of innovative management methods at enterprises in the real sector of the economy. The introduction of innovations in the management system of educational institutions should focus on teaching, scientific research and improving the quality of education. So far, significant progress has been made in reforming the system of innovation management in educational institutions, but the reform focuses mainly on the division of functions and system integration in colleges and universities, while the primary focus should be on teaching and research. It is noted that each of the theories is not ideal and cannot be implemented in its pure form. However, by taking the

best of each theory, it is possible to build an effective management system that will consider the sources of funding of the educational institution, its structure, size, scientific research, ratings and other factors.

It is emphasized that China implements the policy of popularizing higher education, the spatial structure of higher education has changed significantly. Due to the rapid development of the Chinese economy, the strategy of creating "world-class" universities has been implemented. However, state investments in the development of education are insufficient. The problem of low investment efficiency remains, which to some extent leads to an imbalance in regional economic development; secondly, China's higher education institutions still lack an effective investment management mechanism. Institutions of higher education cannot take full advantage of public investment for their development, which leads to inappropriate use of educational funds and low efficiency of costs and results, which seriously limits the long-term development of colleges and universities. It is noted that from the point of view of analyzing regional differences in the efficiency of allocations for higher education, the government takes as an example the eastern, central and western regions of China. Four hypotheses are proposed. Data analysis is used to measure the performance of public investment in the development of educational institutions, and comprehensive efficiency is divided into scale efficiency and pure technical efficiency. Panel Tobit regression model was used for empirical analysis according to the influence of various economic and social factors on regional public investment performance in combination with existing literature.

Five evaluation indices were selected: investment in education, infrastructure investment, scientific research, investment in innovation and additional investment in education. For the first time, the relationship between the amount of public investment and the efficiency of educational institutions in China is analyzed. The results are consistent with hypotheses H1, H2, and H3, and H4 is rejected.

It is noted that the driver of the implementation of effective management of innovation processes in institutions of higher education should be using of artificial intelligence. There is a need to change the basic theory of artificial intelligence, to focus on the research of theories, methods, tools and systems related to artificial intelligence.

In addition, it is important not only to focus on the key areas of artificial intelligence innovation, but also to focus on first-class talents and high-level think tanks in the key areas of artificial intelligence innovation, and to strengthen international academic exchange and cooperation.

The aspect of human resource management innovations in higher education institutions is dominated by expert opinion, which is based on an isolated assessment of project content and does not have an effective index system as a reference. Therefore, the issue of creating an effectively functioning index system is an urgent problem. Based on a detailed study of scientific works, the principles of evaluating the effectiveness of scientific research projects are proposed, as well as the use of the Delphi method to create performance evaluation systems for teachers in various types of colleges and universities. A team of 32 experts representing HR departments was selected and after three rounds of feedback and modifications, 6 first-level indicators and 20 second-level indicators were selected. Among the indicators, educational technologies occupy the largest share, scientific research achievements are in second place, and educational technologies are in third place.

The work reflects the innovative application of marketing theory (principle 4I of Internet marketing) to the study of the university library knowledge service. Thanks to the successful marketing example of 42 world-class universities, the application of the micromedia platform in the marketing of knowledge services and the promotion of the activities of university libraries was analyzed. The author proposes an appropriate marketing strategy, which aims to provide a basis for the library's development of a knowledge service marketing plan and plays an important role in the development and modernization of the library business. On the basis of previous studies, 7 hypotheses were put forward and tested. Based on the 4I principle of network integrated marketing and a three-dimensional communication model, a dynamic model of micromedia marketing of the knowledge service of university libraries was built. The results indicate that this is consistent with hypotheses H1, H3, H4, H5, and H7, but inconsistent with H2 and H6. The results of the study can be the basis for developing a strategy for the

development of university libraries and play an important role in promoting the development and modernization of information services of higher education institutions.

It is emphasized that China must strongly support the development of private educational institutions, attract all possible resources to invest in the education industry, and constantly improve the quality of teaching in educational institutions, which will contribute to the economic growth of the territories in the future. Unlike enterprises, loans to educational institutions are not solved the problem of shortage of funds for production, operation and long-term development. The received loan funds are used to improve the work of educational institutions and the quality of teaching. It has been proven that credit projects in educational institutions have differences in the identification of potential risks compared to lending in the real sector of the economy. It is noted that the services provided by educational institutions belong to quasi-public goods. Even if there are some differences between private and public colleges and universities, the quasi-public good attribute of their services still exists. It is well-founded that the publicity of educational institutions and the autonomy of private colleges and universities force private colleges and universities to be responsible for paying the principal amount of debt and interest on loans. The risk management evaluation system should consist of five levels: management environment, risk assessment, management activities, information and communication, and internal development. These five levels are considered the main ones. Each of the above levels has its own elements of risk management. The hypothesis that banking institutions should formed a risk assessment system in accordance with the main characteristics of educational institutions has been proven. Calculations have proven that educational institutions belong to the category of organizations with a high degree of risk.

Management strategies aimed at creating an effective system of innovative development in educational institutions were considered, and factors affecting the success of innovative initiatives were also investigated. The impact of innovations on improving the quality of education, the development of scientific research, and the training of competitive graduates is analyzed. The dissertation work aims to provide practical recommendations for heads of educational institutions regarding the optimal

management of innovative processes in order to increase competitiveness in the market of educational services, adapt to the requirements of the modern educational environment and ensure sustainable economic growth.

Keywords: management, innovation, intellectual capital, higher education institutions, China, colleges, universities, competitiveness, development, efficiency, economic grow, marketing, loans, risk management, state regulation

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АНОТАЦІЯ

Фу Яньцзюнь. Управління інноваційними процесами у закладах вищої освіти. Дисертація на здобуття наукового ступеня доктора філософії (PhD) за спеціальністю 073 Менеджмент. Сумський національний аграрний університет, Суми, 2023.

Дисертаційна робота є актуальним дослідженням, що присвячене питанням управління інноваційними процесами у закладах освіти задля підвищення їх конкурентоспроможності та адаптації до вимог сучасного освітнього середовища.

Досліджено чотири основні теорії управління. Визначено їх переваги та недоліки, які враховують специфіку діяльності закладів освіти Китаю. Теорія ієрархії наголошує на відмінності розподілу праці на різних рівнях управління закладами освіти. При побудові інноваційної системи управління слід враховувати розмір закладу, розподіл предметів і дисциплін, формування організаційної системи з ефективним контролем та координацією на нижчих рівнях. Теорія людського капіталу має велике значення у контексті обговорення функції закладів освіти і напрямків впровадження інновацій у систему управління. Розуміння соціальної цінності є важливою основою для визначення функції закладів вищої освіти. Повне усвідомлення відмінностей між потребами у людському капіталі та динамізмом розвитку економічних систем визначають масштаб професійного розвитку закладів освіти та всього суспільства. Відповідно теорії конкурентоспроможності, управління закладами освіти не може копіювати набір інноваційних методів управління на підприємствах реального сектору економіки. Впровадження інновацій у систему управління закладами освіти повинно зосередитися на викладанні, наукових дослідженнях та покращенню якості освіти. Наразі досягнуто значного прогресу у реформуванні системи інноваційного управління у закладах освіти, але реформа зосереджена в основному на розподілі функцій та системній інтеграції в коледжах та університетах, тоді як першочергова увага повинна приділятися навчанню та науковим дослідженням. Констатується, що кожна з теорій не є ідеальною і не може бути впроваджена у чистому вигляді. Проте, беручи найкраще з кожної теорії, можна побудувати

ефективну систему управління, яка буде враховувати джерела фінансування закладу освіти, його структуру, розмір, наукові дослідження, рейтинги та інші фактори.

Наголошується, що Китай реалізовує політику популяризації вищої освіти, просторова структура вищої освіти суттєво змінилася. Через стрімкий розвиток економіки Китаю впроваджено стратегію будівництва університетів «світового класу». Проте державні інвестиції у розвиток освіти є недостатніми. Зберігається проблема низької інвестиційної ефективності, що певною мірою призводить до дисбалансу регіонального економічного розвитку; по-друге, вищим навчальним закладам Китаю досі не вистачає ефективного механізму управління використанням інвестицій. Заклади вищої освіти не можуть повною мірою скористатися державними інвестиціями для свого розвитку, що призводить до неналежного використання освітніх коштів і низької ефективності витрат і результатів, що серйозно обмежує довгостроковий розвиток коледжів та університетів. Констатується, що з точки зору аналізу регіональних відмінностей у ефективності асигнувань на вищу освіту, уряд бере за приклад східні, центральні та західні регіони Китаю. Запропоновано чотири гіпотези. Аналіз даних використовується для вимірювання продуктивності державних інвестицій у розвиток закладів освіти, а комплексна ефективність поділяється на ефективність масштабу та чисту технічну ефективність. Згідно з впливом різних економічних і соціальних факторів на регіональну продуктивність державних інвестицій, у поєднанні з наявною літературою, для емпіричного аналізу була використана панельна регресійна модель Tobit. Обрано п’ять індексів оцінки: інвестиції в освіту, інфраструктурні інвестиції, наукові дослідження, інвестиції у інновації та додаткові інвестиції в освіту. Вперше проаналізовано взаємозв’язок між розміром державних інвестицій та ефективністю діяльності закладів освіти в Китаї. Результати узгоджуються з гіпотезами H1, H2 і H3, а H4 відхилено.

Відмічається, що драйвером впровадження ефективного управління інноваційними процесами у закладах вищої освіти повинно стати використання штучного інтелекту. Констатується необхідність зміни базової теорії штучного

інтелекту, зосередження на дослідженні теорій, методів, інструментів і систем, пов'язаних зі штучним інтелектом. Крім того, важливим є не лише зосередження на ключових сферах інновацій штучного інтелекту, а й зосередження на першокласних талантах і аналітичних центрах високого рівня в ключових сферах інновацій штучного інтелекту, посилення міжнародного академічного обміну та співпраці.

В аспекті інновацій управління людськими ресурсами у закладах вищої освіти домінує експертна думка, яка базується на ізольованому оцінюванні змісту проекту та не має ефективної системи індексів як орієнтира. Тому питання побудови працездатної системи індексів є актуальною проблемою. На основі детального дослідження наукових праць запропоновано принципи оцінювання ефективності науково-дослідницьких проектів, а також використання методу Delphi для побудови систем оцінки ефективності для викладачів у різних типах коледжів та університетів. Була відібрана команда з 32 експертів, що представляли відділи управління персоналом та після трьох раундів відгуків і модифікацій було відібрано 6 індикаторів першого рівня та 20 індикаторів другого рівня. Серед індикаторів найбільшу вагу мають освітні технології, другу вагу – науково-дослідницькі досягнення, третю – навчальні технології.

У роботі знайшло відображення інноваційне застосування теорії маркетингу (принцип 4I Інтернет-маркетингу) до вивчення університетської бібліотечної служби знань. Завдяки успішному маркетинговому прикладу 42 університетів світового класу проаналізовано застосування мікромедійної платформи у маркетингу послуг знань і просуванні діяльності університетських бібліотек. Автором пропонується відповідна маркетингова стратегія, яка має на меті забезпечити основу для розробки бібліотекою маркетингового плану служби знань і відіграє важливу роль у розвитку і модернізації бібліотечної справи. На основі попередніх досліджень висунуто та перевірено 7 гіпотез. На основі принципу 4I мережевого інтегрованого маркетингу та тривимірної комунікаційної моделі побудовано динамічну модель мікромедіа-маркетингу служби знань університетських бібліотек. Результати показують, що це узгоджується з

гіпотезами H1, H3, H4, H5 і H7, але не узгоджується з H2 і H6. Результати дослідження можуть бути основою для розробки стратегії розвитку університетських бібліотек і відіграють важливу роль у сприянні розвитку та модернізації інформаційних послуг закладів вищої освіти.

Наголошується, що Китаю необхідно рішуче підтримувати розвиток приватних закладів освіти, залучати всі можливі ресурси для інвестування в індустрію освіти та постійно покращувати якість викладання у закладах освіти, що у майбутньому буде сприяти економічному зростанню територій. На відміну від підприємств, позики закладам освіти не покликані вирішити проблему дефіциту коштів для виробництва, експлуатації та довгострокового розвитку. Отримані кредитні кошти використовуються задля покращення роботи закладів освіти та якості викладання. Доведено, що кредитні проекти у закладах освіти мають відмінності стосовно ідентифікації потенційних ризиків порівняно з кредитуванням реального сектору економіки. Констатується, що послуги, які надають заклади освіти, належать до квазісуспільних благ. Навіть якщо існують певні відмінності між приватними та державними коледжами та університетами, атрибут квазісуспільних благ їх послуг все одно існує. Обґрунтовано, що публічність закладів освіти та автономія приватних коледжів та університетів змушують приватні коледжі та університети нести відповідальність за виплату основної суми боргу та відсотків за кредитами. Система оцінки управління ризиками повинна складатися з п’яти рівнів: управлінського середовища, оцінки ризиків, управлінської діяльності, інформації та комунікації та внутрішнього розвитку. Ці п’ять рівнів розглядаються як основні. Кожен з наведених рівнів має власні елементи управління ризиками. Доведено гіпотезу про те, що банківські установи повинні будувати систему оцінки ризиків відповідно до основних характеристик діяльності закладів освіти. Прораховано, що заклади освіти належать до категорії організацій з високим ступенем ризику.

Розглянуто стратегії управління, спрямовані на створення ефективної системи інноваційного розвитку у закладах освіти, а також досліджено фактори, які впливають на успішність інноваційних ініціатив. Проаналізовано вплив

інновацій на підвищення якості освіти, розвиток наукових досліджень та підготовку конкурентоспроможних випускників. Дисертаційна робота має на меті надати практичні рекомендації для керівників закладів освіти щодо оптимального управління інноваційними процесами з метою підвищення конкурентоспроможності на ринку освітніх послуг, адаптації до вимог сучасного освітнього середовища та забезпечення стійкого економічного зростання.

Ключові слова: менеджмент, інновації, інтелектуальний капітал, заклади вищої освіти, Китай, коледжі, університети, конкурентоспроможність, розвиток, ефективність, економічне зростання, маркетинг, кредити, управління ризиками, державне регулювання.

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LIST OF SYMBOLS

AI – Artificial intelligence

AHP – Analytic Hierarchy Process

DEA – Data Envelopment Analysis

DMU – Decision Making Unites

GFHE – Government investment in higher education

PHEI – Private Higher educational institution

PTE – Pure technical efficiency

SE – Scale efficiency

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INTRODUCTION

Relevance of the topic. In recent years, the reform of the higher education management system has become one of the hot issues concerning the whole society. Never before has higher education been paid so much attention and attention with such enthusiasm. At the same time, universities have never faced so much competitive pressure.

Higher education system reform mainly revolves around two lines: one is the reform of the macro level, mainly is the higher education system and the adjustment of education structure, including the management system of colleges and universities, educational system, financing system, the recruitment of students employment system and the adjustment of subordinate relations in colleges and universities, colleges and universities merger of running a school, the relationship between government and universities, etc.; second, the reform at the micro level, mainly the reform of the management system of colleges and universities, such as streamlining the organization and changing the mechanism; reducing staff and increasing efficiency, and diverting redundant staff; full employment and equal competition; logistics services, social and so on. These two levels are interrelated and complementary. Without the background of macro reform, it is difficult to carry out micro reform. Some scholars put forward that the crux of university management system reform lies in the current university management system on the basis of analyzing the restricting factors of management system reform. Of course, without the support of micro reform, macro reform would be meaningless, or at least difficult to achieve.

The reform of China's higher education system is speeding up, and the reform of all aspects of higher education has come to a very critical moment. There is an urgent need to vigorously promote a new round of internal system reform of colleges and universities, which is the reform of higher education to consolidate the achievements. We must reform, hurry up and make great efforts to reform. This thesis mainly studies the reform of management system at the micro level.

The literature review was based on the research of Ukrainian and Chinese scientists, and representatives of developed countries. The literature review was based on the research of Ukrainian and Chinese scientists, and representatives of developed countries. The works of Chinese and foreign scientists such as Danian Wang, Feng Gao, Liu Z, Wang C, Liu Z, Wang C, V.L ynn Meek, Patrie Thomas, Vojin Rakic, R. C. Ballinger, Alan Day Haight, Roemer, Steiner devote to the research issue of University management system. In this context, the reform of the higher education system is mainly carried out in two lines: First, the reform at the macro level is mainly the adjustment of the higher education system and education structure, including the adjustment of the management system of colleges and universities, the school running system, the fund raising system, the enrollment and employment system, the subordination relationship of colleges and universities, the merger of colleges and universities, and the relationship between the government and colleges and universities. The second is micro-level reform, mainly the reform of the management system of colleges and universities, such as streamlining the organization and changing the mechanism; Reducing staff to increase efficiency and redistributing redundant staff; Full employment, equal competition; Logistics services, to the community, etc. The existing research has played a positive role in promoting the reform of the management system of colleges and universities. But these studies are still lacking, so it is difficult to adapt to the requirements of the new situation of university management system reform. Therefore, this study will combine the new environment of college development, on the basis of historical review and performance analysis of the traditional college management mode, comprehensively apply the multidisciplinary knowledge of economics, management science, pedagogy, etc. to systematically study the reform of China's college internal management system, especially the innovation of higher internal management mode under the background of marketization, network and globalization.

Connection of work with scientific programs, plans, topics. The dissertation was carried out in accordance with the directions of research works of the Department of Management of the Sumy National Agrarian University: «Development of management in the context of international integration processes» 2019-2023 (state

registration number 0119U001336), within which the author has made an exploratory research on the innovation of university management system; Department of Finance, Banking and Insurance of the Sumy National Agrarian University: «Formation of a mechanism for managing the innovative development of higher education institutions» 2021-2022 (state registration number 0121U108135) within which the author has made describes the priorities of university management system innovation.

The purpose and tasks of the research. The dissertation work is devoted to the substantiation of theoretical and methodological principles and the development of practical suggestions for the management of innovative processes of higher education institutions, and comprehensively expounds the proposition that the management system of higher education institutions must be innovative.

In accordance with the goal, the following tasks were set and solved:

- to investigate the evolution of scientific development concepts on the innovative nature of the university management system

- to investigate modern theories of management of innovative processes in higher education institutions;

- to analyze features of state financial support for the development and innovation management of higher education institutions: regional aspect;

- to model the success of the development of higher education institutions;

- to determine the marketing and promotion of knowledge services based on the micromedia model as a part of innovative processes in higher education institutions;

- to provide the strategy for using artificial intelligence as a basis for introducing innovations in the management and development of higher education institutions;

- to evaluate risk management of credit projects in higher education institutions

- to build a system of indices for evaluating scientific research activity based on the Delphi method.

The object of the research is the management of innovative processes of higher education institutions.

The subject of the research is economic and organizational-legal relations arising in the process of managing innovative development of higher education institutions.

Applicant's personal contribution. The dissertation is an independently performed scientific work. All the results of the study, presented in the paper and presented for defense, are received by the author personally.

Research methods. Research methods. The first is to focus on normative research, combining normative research with empirical research. First, with the help of economics, management, pedagogy, law, and other disciplines, using the method of normative research, the internal management reform of colleges and universities is theoretically analyzed, and the theoretical research framework is built. Then combined with the concrete practice of internal management in Chinese universities, the management innovation is elaborated. Second, it is based on logical analysis, combining logical analysis with historical analysis. At the same time, fully consider the particularity of educational culture in the world and the epokality of educational development in different historical periods, and adhere to the combination of logical analysis and historical analysis. Third, the comprehensive analysis is the main, and the comprehensive analysis is combined with the special research. To grasp the overall problem from the whole, comprehensive analysis. Some important issues in the internal management of colleges and universities, such as teaching management innovation, and incentive system innovation, are studied in order to not only take care of the general but also ensure the focus. Graphical and tabular methods were used for visual presentation of the obtained results.

Scientific novelty of the obtained results. The most important research results that reveal the content of the dissertation, characterize its scientific novelty and are presented for defense include the following:

First obtained:

an innovative application of marketing theory based on the 4I principle of Internet marketing to the study of the university library knowledge service was proposed by creating a micromedia platform, which aims to provide a basis for the library to develop

a marketing plan for the knowledge service and plays an important role in the development and modernization of the librarianship, which, in turn, will contribute to the development and modernization of information services of higher education institutions and, in the final case, will ensure the provision of quality educational services;

Improved:

an artificial intelligence-based innovation management system for higher education institutions by changing the basic theory of artificial intelligence, focusing on the research of theories, methods, tools and systems related to artificial intelligence and focusing on first-class talents and high-level think tanks in key fields innovations of artificial intelligence, strengthening of international academic exchange and cooperation of higher education institutions.

regulation of the university administration, which must go through two stages: the administrative management of innovative processes entails an increase in administrative efficiency and success. The management of innovation processes focuses on 4 aspects: compliance with rules, specialization, impersonal management and hierarchical control, which ensures the efficiency of the organization of internal administrative processes and is the basis for improving the university administration for the effective management of higher education institutions.

the credit risk management system of private institutions of higher education by recognizing the targeted nature of the use of credit funds and the quasi-community of educational services aimed at improving the work of private educational institutions and the quality of teaching, consists of five levels: management environment, risk estimation, management activities, information and communication and internal development and is able to provide an effective mechanism for reducing a high degree of risk, which in the future will contribute to the economic growth of the territories in the future.

Further development:

theoretical principles of creating an effective management system for innovative processes in institutions of higher education, which are based on the main theories of management and provide for their synergistic influence due to considering the size of

the educational institution, the distribution of subjects and disciplines, the formation of an organizational system with effective control and coordination at lower levels in order to realize differences between the needs of human capital and the dynamism of the development of economic systems for the development of educational institutions and society as a whole.

substantiation of approaches to state support for the management of innovative processes in institutions of higher education, which is based on the strategy of creating «world-class» universities in China and, unlike existing approaches, eliminates the imbalance of regional economic development and stimulates the creation of an effective management mechanism for the use of state investment funds based on set of evaluation indices: investment in education, infrastructure investment, scientific research, investment in innovation and additional investment in education for the long-term development of educational institutions and is based on the use of the Tobit regression model.

methodological approaches to the construction of an effectively functioning system of evaluation of research projects with an innovative focus in higher education institutions based on the use of the Delphi expert evaluation method by selecting 6 indicators of the first level and 20 indicators of the second level, among which the educational technologies occupy the largest share, scientific research achievements are in second place, and educational technologies are in third place.

The scientific and practical significance of the dissertation. Sorting out the historical problems and future development of the management system of universities, it also improves the competitiveness of Chinese and Ukrainian universities in the world. Since the core value of university development is to serve people's livelihood, this study has a high strategic value. This study not only has a high value in restoring the essence of university management but also to the development of higher education but also has a promoting role in fully protecting the national interests outside the economy and the implementation of China's education economy. Separate research subjects are recommended for implementation in the activities of Sumy National Agrarian University and Sumy Vocational College.

Personal contribution of the applicant. The PhD student has searched and analyzed literature sources on the topic of the work, selected methods and techniques, statistical processing, and analysis of the results. Interpreter and generalize the obtained results, draw the dissertation's conclusions, and make practical recommendations under the supervisor's guidance.

Approbation of the results of the dissertation. The main provision sand results of the dissertation research were made public by the author at conferences, seminars, meetings, among which the most important was: International Scientific-Practical Conference «Financial and economic development of Ukraine in the conditions of transformational transformations» (March 28, 2019, Lviv), International Scientific-Practical Conference «Sustainable development of the national economy: current problems and mechanisms of support» (April 26, 2019, Kryvyi Rih), International Scientific-Practical Conference «Management of the 21st century: globalization challenges» (April 23-24, 2019, Poltava), International Scientific-Practical Conference «Innovations of partnership interaction of education, economy and social protection in conditions of inclusion and pragmatic rehabilitation of society» (April 19-20, 2019, Kamianets-Podilskyi), Innovation Management and information Technology impact on Global Economy in the Era of Pandemic (37th International Business Information Management Association (IBIMA), 30-31 May 2021, Cordoba, Spain), SNAU International Conference (Sumy, Ukraine, 2019-2021).

Publications. The main results of scientific research were published in 12 scientific articles: 2 articles in specialized publications of Ukraine, 2 articles in journals included in the scientometric databases Scopus and Web of Science, the rest- in other journals and conference proceedings.

Structure and scope. The dissertation consists of an introduction, three chapters, conclusions, a list of references and appendices. The total volume of work is 202 pages. The work contains 36 tables and 10 figures. The references consist 187 publications.

CHAPTER 1. THEORETICAL AND METHODOLOGICAL BASIS MANAGEMENT OF INNOVATIVE PROCESSES IN HIGHER EDUCATION INSTITUTIONS

1.1. The innovation direction of the university management system under the guidance of the scientific development

In recent years, in view of the impact of knowledge economy, network and globalization on higher education, many scholars around the world have carried out in-depth research on deepening the reform of university management system.

Higher education has a history of hundreds of years. From the macro operation mechanism of higher education management, the management models of various countries have their own traditions and characteristics, but generally have strong adaptability to market system. The management model of British universities is characterized by «academic oligarchy». Although the funding of British universities has always been mainly from the government, the universities have a great deal of autonomy in the use of funds. Academic staff have more power in dealing with the internal affairs of the university. After the 1980s, Britain began to implement the liberal economic policy, which greatly reduced the government's investment in universities and injected market factors into higher education. It began to turn its attention to market demand, students and the business community, and the degree of competition between universities has been significantly improved. In recent years, the scholars on the English university internal management is depressing reflection, that is to improve the internal governance structure and management mode and organization of academic work, "refused to discuss the university internal management priority, not only causes school tyranny and chaos, but it can also cause the waste of resources.

Other countries in continental Europe have conducted extensive studies on marketization, internationalization and integration of higher education in continental Europe. For example, on the basis of summarizing the development experience of higher education in Britain, France proposed that university education should be gradually

transformed to the track of internationalization and globalization. It is suggested that the layout of universities should be based on the functions, cultural traditions and characteristics of education so as to promote exchanges and cooperation between schools. In recent years, the rapid development of the cause of higher education in Australia can cause about higher education mode to meet the needs of market and economic development of debate, V.L ynn Meek and other scholars as far as the relationship between the government and the university and the university internal governance structure were studied called believes that Australia's university decision-making process cumbersome, governance structure is imperfect, lack of management efficiency, Therefore, the expansion of the number and scale of universities should be accompanied by educational innovation management according to the standards of the Commonwealth education system, especially the management innovation within universities. Of course, the privatization and competitive efficiency of higher education are also important contents of the study.

American higher education has obvious market characteristics. 40% of the funds of public universities come from the state government and 15% from the federal government. About 20 percent of private college funding comes from the state and federal governments. Universities compete with each other for students and research projects. At the same time, planning also plays a very important role in the management of higher education in the United States. Part of the reason for the existence of multi-campus universities is to «avoid unnecessary duplication and competition». The multiple goals of universities can be achieved more effectively by adopting a relatively centralized management form rather than relying on the free cooperation between schools.

In recent years, influenced by the rapid development of modern science and technology, colleges and universities in the United States, Britain, Germany and other developed countries are also constantly adjusting their development strategies and internal management systems. In addition to the above marketization research, the academic circle is also very concerned about the innovation of the management system of colleges and universities, and has conducted a lot of valuable research. To sum up,

the following aspects of research in this field are more eye-catching.

First, research on the relationship between universities, enterprises and society. In recent years, there has been a heated debate on the relationship between universities and enterprises on university campuses in Britain and America. The debate centers on whether universities should maintain an independent scientific spirit or serve the development of industry. The most typical debate occurred at the University of California, Berkeley. In November 1998, the university signed an agreement with Novartis, the Swiss pharmaceutical giant and producer of genetically modified crops, under which Novartis provided $25 million to fund basic research in the department of Plant and Microbiology. The university has agreed to grant novartis a franchise for 1G of the department's research and to include two representatives from the company on the department's five-person research committee. The agreement has generated strong reactions both inside and outside the school. In schools, 41 percent of teachers surveyed supported the agreement; 50 percent of teachers opposed the deal, saying it would have a negative impact on academic freedom. Off campus, America passed the Becherdor Act in 1980, which allowed companies to provide financial aid to universities. As a result, large amounts of private capital flowed into schools. According to statistics, industry funding for academic research grew at an average annual rate of 1 percent from 1980 to 2018. However, this law has aroused fierce controversy from the very beginning. Quite a number of studies believe that research and exploration without selfish motives is the primary value of higher education, and commercial forces cannot be allowed to determine the scientific spirit, educational mission and academic goals of universities.

Another example is the research on management evaluation of colleges and universities. American educational circle attaches great importance to the study of management assessment. For the evaluation of colleges and universities, they have carried on the in-depth research from the evaluation method or technology and evaluation content. In terms of Approaches and techniques, they are not in favor of talking about evaluation in terms of evaluation. They believe that evaluation should first determine the purpose of evaluation. There are two main problems: one is for whom evaluation is made, whether it is for investors, managers, political leaders or customer

groups; The second question is what problems to solve, whether to improve the quality of education, reduce costs or improve work performance. Different methods are used for different purposes. The theory of management Evaluation is called the Assumption about the purposes of Evaluation. In terms of the assessment content, they divide the assessment into two parts from three levels: overall, teaching and scientific research:

1. Performance appraisal is essentially an evaluation of Objectives, and Departments that evaluate employees' Objectives.

2. That is to say, to evaluate the degree of realization of university goals, Patrie and Thomas refined the measurement indexes to improve organizational performance from the perspective of teachers' cognition.

Bowen transplanted the concept of resource allocation efficiency into the field of higher education research. He studied at the university of America, the relationship between the financial status and resource allocation form of found that with the improvement of university financial level, a greater proportion of resource is configured in the «student services», «employment of academic staff» and «purchase» and other indirect education link, and think that this is «engel's law» in the form of higher education. At the same time, European and American scholars also carried out empirical analysis on the sharing of educational resources in the region. For example, Dutch scholar Vojin Rakic analyzed the necessity of higher education policy integration of The Netherlands, Belgium and Germany and its impact on higher education of other countries in the continent from the perspective of the development of higher education in the European continent. It is believed that educational integration is beneficial to the flow of students and the improvement of teaching quality, but it will not form a significant impact on the existing higher education system, while British scholars put forward the goal, structure and management mode of educational market integration in coastal areas from the perspective of management integration, economic development and regional division of labor. R.C. Ballinger and other scholars verified the role of education market integration from the industry background of shipping policy. Alan Day Haight, an American scholar, proposed the iron law of wages through microscopic investigation and analysis.

The conclusion that thorough planning, psychological adaptation, and human resource principles will improve wage performance in all industries is also confirmed in the Roemer and Steiner study. In developing countries, the most important issues economists care about are increasing tuition fees, attracting foreign students, accepting donations from enterprises and foreign governments, and enterprise-like management of universities.

International scholars mainly focus on how the internal management of universities adapt to economic development and technological progress. This research perspective is determined by the specific system of foreign universities. As the higher education of developed countries such as the United States and Britain has existed in the market system for a long time, their internal management is based on the market system. The practice of university management determines the trend of university management theory. Most of the problems to be solved by the management of colleges and universities are related to the progress of science and technology and the development of social economy, that is, how to adapt the internal management to the external environment.

The research on the internal management of universities in China is also to meet the requirements of university reform. Since the 1990s, as the reform of higher education system has gradually deepened from macro to micro, the reform of logistics and personnel distribution system has set a precedent for the reform of internal management in colleges and universities. In 1993, the former state education commission has issued the «opinions on reform of the higher school internal management system, the reform of internal management system of colleges and universities directly under the state education commission of several opinions» and «about colleges and universities directly under the state education commission to deepen reform, expand school-running autonomy of several opinions and other three files, so as to effectively promote the internal management system of colleges and universities». Therefore, the internal management system has become an important issue concerned by the theoretical circle.

The research on the reform of internal management system in colleges and universities in China mainly follows several ideas. The first is the study on the deficiency,

which mainly analyzes the conditions and preparations needed for deepening the reform of internal management system, especially the preparation for thinking and social environment. Some scholars think that the choice of ideas is the guarantee and premise of the reform of the internal management system of colleges and universities, while others think that democratization and the construction of the rule of law is the target trend and key of the reform of the internal management system of colleges and universities. Some scholars believe that price mechanism, supply and demand mechanism and competition mechanism in the operation of socialist market system must be introduced into the internal management of colleges and universities to promote the development of various reforms in colleges and universities. Most scholars believe that the reform of the internal management system of colleges and universities involves the vital interests of teachers. First of all, it is necessary to combine the reform with the competition mechanism and the modernization of education. Many scholars believe that the reform of colleges and universities must be based on the corresponding social environment. Without external competitive pressure and social support, college reform will inevitably fall into despair. For example, without a labor market, it is difficult to reform the personnel distribution system in colleges and universities. Of course, the analysis of the meaning function, necessity and urgency of the reform of the internal management system of colleges and universities occupies a considerable proportion in the so-called research on the deficiency.

The second is the research on the target system of the reform of the internal management system in Chinese universities. Many scholars believe that the goal of the reform of the internal management system of colleges and universities in China is to establish a standardized, coordinated, high-quality and efficient management system centering on teaching and scientific research by adjusting and optimizing the functional structure, rights, responsibilities and benefits, institutional layout and leadership system. Establishing a democratic school running system that relies on the democratic participation, democratic decision-making, democratic management and democratic supervision of the staff; Construction of high-quality teachers and management team, improve the employment, assessment and reward and punishment system, improve the

overall quality of the staff. Some scholars believe that the reform goal of the internal management system of Chinese colleges and universities is to establish five mechanisms, that is, the organization mechanism with efficient operation, the management mechanism with self-restraint, the employment mechanism with incentive competition, the distribution mechanism with strong guarantee and the supervision mechanism with sensitive control.

Third, the focus of the reform of the internal management system or specific issues of the thematic research. According to the stage and situation of the reform of the internal management system of Chinese colleges and universities, the educational circle has focused on the reform of the employment system, the reform of the wage distribution system, the reform of the socialization of logistics, the guarantee of the flow of talents and the service system. At a symposium on reforming the internal management system of colleges and universities held in Shanghai in May 2019, the education administrative departments of Shanghai, Shanxi and Liaoning and five universities, including Shanghai Jiao Tong University, Wuhan University, Xiamen University, Hunan University and Harbin Institute of Technology, shared their experiences. It is widely believed that deepening reform is necessary to improve the quality of education, the level of scientific research, the level of management and the efficiency of running schools so as to speed up the construction and development of schools. In recent years, experts and leaders of colleges and universities around the country have also put forward specific methods and ideas for deepening the reform of the internal management system according to the reform practice of their own units.

Professor Yang Xueli distribution system is put forward on the egalitarianism dampened the enthusiasm of the staff and creativity, should according to the principle of «stock of the same, incremental away», strengthen post, post salary, calculate, the optimal optimal reward, and drop the rich floor et al., compares the different concrete practice, the reform of college personnel system that to further promote the change of employee ideas in colleges and universities, Accelerating the pace of the reform of the personnel system in colleges and universities and creating a social environment for the reform are the priorities of the reform of the internal management system in colleges and

universities. From the perspective of system integration, some scholars put forward that the effective integration and development of talents to form sustainable and core competitiveness is one of the problems that colleges and universities must try their best to solve in the internal management system reform.

Fourthly, starting from the practice of merging school running, it analyzes and studies the countermeasures of optimizing the mode of resource allocation, perfecting the internal management system and improving the efficiency of school running. Some scholars believe that the organizational expectations of merging schools are easy to achieve, while the functional goals of merging schools are more difficult to achieve. This is because of the following obstacles in the allocation process of educational resources in merged universities: the restraint of educational organization reform, the complexity of personnel coordination, the inherent nature of the original physical and chemical resources, and the difficulty of interdisciplinary integration. Therefore, we should adhere to the principle of power, efficiency and sustainable development, and correctly handle the relationship between breaking and standing, inheritance and development, balance and imbalance, tangible resources and intangible resources in the process of integrated development. In terms of the dynamic mechanism and operational thinking of the merger, some scholars believe that the higher education is not fully equipped with the market allocation of resources, the merger and adjustment of colleges and universities must strengthen the government behavior. At the same time of the merger and adjustment, further deepen the school management system reform, through institutional innovation, realize the reorganization and optimization of resource allocation. Some scholars think that merging the realization of the educational goals by collision, such as different value orientation, school idea, staff emotion, cadre of ranking ideas such as restriction and the influence, therefore, substantive consolidation must be solid line five «unity», achieve five:

1) «convergence» unified school the main body, achieve the campus fully mix;

2) implement unified leadership and management to achieve full integration of institutions and personnel;

3) the implementation of a unified management system, to achieve the full

integration of school management activities;

4) implement a unified development plan to achieve full integration of work objectives and ideas;

5) implement unified construction of subjects to achieve full integration of subjects and specialties.

It should be said that there are many studies on the feasibility and principle of university merger from a strategic perspective, and such discussions are still continuing up to now. For example, Pang Qingshan et al discussed some basic relations that should be handled well by university merger from the perspective of system science: Scale and scale economic benefits, resource reorganization and improvement of resource utilization rate, discipline juxtaposition and discipline integration, adjustment of layout and optimization of structure, etc. Zhou Zhengdi et al. analyzed the conflicts of interests and solutions of university merger from the perspective of economics, and proposed that the way out of deepening the reform of university management system lies in: change «exogenous» reform into «endogenous» reform; we should use dynamic and developmental perspectives to solve the difficulties and problems encountered in the reform and maintain a certain tension between gradual reform and radical reform. From the practice of tongji University's system reform, Professor Wu Qidi put forward the principle that «complementary merger» should emphasize the historical and traditional origin relationship, and «similar term merger» should focus on key universities.

There is no doubt that the above research has played a positive role in promoting the reform of the internal management system of colleges and universities in China. However, there are still some deficiencies in these researches, so it is difficult to adapt to the requirements of the new situation of the reform of the internal management system of colleges and universities in China. To be specific, there are mainly the following shortcomings: first, there are too many matter-of-fact theories, but few systematic theoretical researches; Second, there are more empirical summaries than prospective studies. Thirdly, there are more principled research, less structural research and less research on the innovation of teaching science system. Fourthly, there are more single-subject studies than comprehensive ones.

1.2. The evolution of scientific development concept on the innovative nature of the university management system

Higher education system reform mainly revolves around two lines:

1) one is the reform of the macro level, mainly is the higher education system and the adjustment of education structure, including the management system of colleges and universities, educational system, financing system, the recruitment of students employment system and the adjustment of subordinate relations in colleges and universities, colleges and universities merger of running a school, the relationship between government and universities, etc.;

2) second, the reform at the micro level, mainly the reform of the internal management system of colleges and universities, such as streamlining the organization and changing the mechanism; reducing staff and increasing efficiency, and diverting redundant staff; full employment and equal competition; logistics services, social and so on.

These two levels are interrelated and complementary. Without the background of macro reform, it is difficult to carry out micro reform. Some scholars put forward that the crux of the internal management system reform of colleges and universities lies in the current management system of colleges and universities on the basis of analyzing the restricting factors of management system reform. Of course, without the support of micro reform, macro reform would be meaningless, or at least difficult to achieve. China's higher education system reform speed up, the reform of higher education in all aspects has come to a very critical moment, urgent need to vigorously promote a new round of college system reform, this is the higher education to consolidate the results of the reform, must be changed, reform, great efforts to change. This paper mainly studies the innovation of university management system at the micro level.

At present, China's institutions of higher learning are undergoing round after round of management system reform. There are macroscopical guidance and guiding factors here, but more important is the impact of external environment changes. To sum up, there are three main factors that catalyze the reform process.

Market-oriented reform China's market-oriented reform has shifted from the purely economic field to social, educational and other aspects. The essence of market economy is to organize resources and provide products or services according to market demand. In the market economy system, universities, as an organization, should be the main body of resource allocation. By allocating corresponding human and financial resources, colleges and universities provide unique products or services for the society. The marketization reform has put forward many new problems and requirements to the internal management system of colleges and universities. These problems and requirements involve all aspects of the university management system. The following three aspects are summarized here.

First, the functions of institutions of higher learning. Organizational management serves organizational functions. In the traditional system, the function of colleges and universities is to complete the teaching tasks prescribed by the superior departments. In the new system, as an independent subject, colleges and universities need to undertake multiple functions such as knowledge creation, knowledge dissemination, service for economic construction and participation in economic construction. Knowledge creation is mainly through scientific research, understanding the objective world more deeply, discovering and summarizing new laws. The dissemination of knowledge is to impart the existing knowledge and experience to students, training students to know the world, the ability to transform the world; the construction of service economy mainly means that colleges and universities should provide talent pool and «think tank» for local economic construction, and provide technical support and decision-making consultation for regional economic development. Participation in economic construction means that colleges and universities should change from the «periphery» to the «center» of economic construction, and become the new force of economic construction directly by setting up industries. The new system entrusts these new functions to institutions of higher learning, increasing the complexity and variability of management. This requires the corresponding reform and adjustment of the internal management system.

Second, competition among colleges and universities. Competition is the basis of market efficiency advantage, and the high efficiency of resource allocation is mainly

brought by competition. In the market economy system, there is competition among colleges and universities. This is a new problem with the new system. Before the market-oriented reform, colleges and universities just fulfilled the tasks of higher authorities. At best, there is competition among colleges and universities, not competition. The difference between competition and competition mainly lies in the following: competition is decided by external judges, and the result itself does not constitute a substantial influence on the participants; Competition is different. It is decided by the participants according to the established rules through their personal efforts, and the outcome itself has a direct impact on the interests of the parties, which is commonly referred to as survival of the fittest.

The existence of competition makes the internal management system of colleges and universities appear more important. According to the theory of competitive advantage, management plays an important role in organizational competition in at least three aspects:

- first, the selection and determination of development strategy;
- the second is to organize resources reasonably around the development strategy, so that they are concentrated in competitive industries and strategic priorities;
- third, we will provide support and guarantee for competitive industries. Specifically to colleges and universities, the competition between schools is the competition between dominant disciplines and majors.

The internal management of a school should first and foremost serve the cultivation of superior disciplines and specialties. At the same time, it is necessary to form a reasonable division of labor within the school's resources, so that the dominant disciplines, majors or core businesses and support can develop in a coordinated manner and complement each other. It is the new requirement of market economy to the internal management of colleges and universities to do the work scientifically, reasonably and efficiently. Third, the way colleges and universities operate. The basic path of organization operation under market system is :

1) discovering demand;

2) determine the target market, that is, market positioning;

3) Carry out product development and production and organize marketing activities around the target market.

The institutions of higher learning in market economy should also follow this basic operating rule. This is no doubt a big challenge for colleges and universities accustomed to traditional operation mode. For example, in the traditional system, school enrollment, teaching, management and so on are regulated by the educational administrative department. Schools don't need to study social needs. In the new system, the primary task of the university is to find out the specific needs of the society for higher education, especially for talent training, including specialty, training specifications, talent quality, education level and regional distribution of talent demand. This is the logical starting point for a school to operate. For most colleges and universities, this is a new undertaking, so it needs a special person or organization to investigate and research. This is the marketization of internal management of colleges and universities put forward a new request. For example, the employment of college students in the traditional system is regulated by the national plan. The school's job is to put specific targets on specific people. In the new system, the employment of students is market-oriented, that is, students and employers make a two-way choice. For colleges and universities, it is necessary to give employment guidance to students. This is a new problem of internal management in colleges and universities. The market-oriented reform affects all aspects of the internal management system of colleges and universities. Here summarized into three aspects, just want to explain the impact of marketization on the internal management of colleges and universities. In fact, the impact goes far beyond these three aspects.

In the past decade, the new economy or knowledge economy represented by computer and Internet has achieved rapid development and become an important force to promote the economic growth of the United States and other developed countries. Moreover, the development of Internet has greatly accelerated the process of economic globalization. At present, networking and globalization have become a worldwide trend. Many scholars predict that the gap in economic development will gradually evolve from the east-West gap to the gap between the Internet and non-internet, and between open

and closed. Networking and globalization have exerted great influence on China's economic and social development. China's social and economic development will be more deeply integrated into the tide of networking and globalization. Higher education is no exception. As far as the management system of colleges and universities is concerned, network and globalization have put forward many new problems. For example, cross-cultural management issues. Colleges and universities mainly train talents for the society and the market. Talent training has two dimensions: technology and morality. In the network age, the speed of information transmission is fast.

Globalization is first and foremost the globalization of information transmission. The influence of foreign culture and values on Chinese teachers and college students is increasingly obvious. This requires cross-cultural management, that is, colleges and universities should do a good job in the education and guidance of teachers and students according to the characteristics of internationalization or globalization. As the carrier of the new economy and globalization, the Internet has changed the division and pattern of the market. After the emergence of the Internet, the boundary between the Chinese market and the international market has gradually blurred and weakened. Under the background of network and globalization, to produce products for the domestic market is to produce products for the international market. The competition has become more intense and complex. In this respect, colleges and universities have been hit hard. A typical example is the impact of Internet-based distance education on universities. In recent years, famous universities in the developed countries of the United States have extended their education market to all parts of the world with the help of the Internet. This has had a significant impact on education markets in countries that used to be relatively independent. Previously, the main competition for universities came from within China; It is time to compete on a global scale. From the perspective of management, it was only necessary to study competitive advantages and participate in the division of labor in China's internal education market before, but now it is necessary to participate in the competition in the global education market based on global education resources. This is naturally a new challenge for China's higher education management, which has just come out of the planned economy system.

«People-oriented, comprehensive, balanced and sustainable scientific development view» is in the process of contemporary social development in China has become an increasingly important position and role of the human subject, especially on the one-sided pursuit of economic growth development comes at a cost to the reflection on the basis of put forward a new idea of development, reflects the new understanding of development issues in China. To set up a scientific view of talent is a basic requirement of implementing the strategy of reinvigorating the country by talent and a concrete embodiment of implementing the scientific view of development. As China continues to publicize, study and thoroughly implement the scientific Outlook on Development, the principle of «putting people first» has been deeply rooted in the hearts of the Chinese people and has exerted a great influence on all undertakings in China. In the process of the reform of the management mechanism of colleges and universities, more and more people have realized that the basic idea of deepening the reform of the management mechanism of higher education in China is to carry out the principle of «people-oriented» and implement humanistic management of colleges and universities. It is an important content of China's higher education mechanism reform to adhere to the principle of people-oriented management and realize the innovation of local university management mechanism.

What is the core idea of people-oriented management theory: adhere to all people-oriented. The principle of humanism is one of the four principles of management. As the name implies, it is the principle of people-oriented. It requires people to adhere to the core of all management activities, take people's rights as the foundation, emphasize the subjective initiative of people, and strive to realize the comprehensive and free development of people. Its essence is to fully affirm the main position and role of human in management activities. However, any management theory has its class and time background, and the humanistic principle is no exception. With the rapid development of science and technology and the arrival of economic globalization, the management philosophy and management practice in various fields have undergone earth-shaking changes, and the humanistic principle has been given a new era significance. Teachers are the main body of the school, and their participation is the key to the effective

management of the school. The core of modern educational management is to make the faculty and students develop their human nature perfectly. Serving the development of staff and students is the fundamental purpose of educational management. Quality management, people-oriented, only by constantly improving the quality of people, in order to continuously improve the quality of activities or processes, product quality, organization quality, system quality and its combination of entity quality, this is the principle of humanism.

Talent is the first element of quality management. Talent refers to those who have certain specialized knowledge and skills in social practice and make contributions to their own work, to understanding and transforming the world, and to the progress of human society through their creative labor. A person who has quality management expertise, skills and contributes to the revitalization and development of the country, industry, region, enterprise, public institution or other organization through his or her creative labor in quality undertakings in quality work practice. In quality management, quality talent is the first element, which plays a decisive role in the development of quality management. From the perspective of the history of modern international quality management, one of the fundamental reasons for Japan's product quality, from inferior to more than that of the United States and Europe, is that Japan attaches great importance to and creates a team of quality talents.

As we all know, the theory of modern quality management was first produced in the United States, the most economically developed country. As Americans such as Shewhart and Feigenbaum took the lead in studying and adopting the scientific method of statistical quality control and total quality management, the quality of American products was rapidly improved and stable, and the economic development of the United States was promoted. In the 1950s, automobiles produced in the United States occupied the international automobile market 80% of Japanese products were of poor quality in the 1940s, which was regarded by the world as a synonym for «inferior products», but after the 1950s, Japan established a strategic policy of quality rejuvenation and education. First, we invited Dr. Deming and other quality management experts from the United States to give lectures, humorously learned statistical quality control theory and

technology from the United States, and cultivated and brought up a group of excellent quality talents such as Shigeru Mizuno, Genichi Taguchi, Kaoru Ishikawa, and carried out quality training and education throughout the quality management. By the 1960s, Japan creatively developed the theory and method of total quality management, has put forward the «quality circle», «TQC», «CWQC» and «whole society quality management» and other new theories and new methods, but also trained a large number of quality talents at various levels. The quality of people determines the quality of products and also determines the economy of the country. In less than half a century, the quality of a large number of Japanese cars, steel, cameras and other products exceeds that of the United States and European countries, ranking in the forefront of the world. Japan, with its large population, small territory and poor resources, sprang up to become the world's economic powerhouse, with gross national product (GMP) per capita surpassing that of the United States in the late 1980s.

Theoretically, people are also the first element of quality management. At present, there are «three elements» and «five elements» of quality management. The theory of «three elements» means that the elements of quality management are people, technology and management. But in these three elements, people are in the dominant position, just like riding a bicycle. The two wheels of the bicycle are the technical and management elements, and the «human» element of the rider plays a leading role in them. Without people, the bike can only be parked like a dead object, can not play any role. «Five elements theory» is that quality management is composed of people, machines, materials, methods and environment, but in these five elements, people are in the central position and driving position. Just like a driving car, the four wheels of the car are «machine», «material», «law», «ring» four elements, the driver of the «human» element is the main, no driver, the car can only stay in place, become waste.

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As far as enterprise quality management is concerned, it is people-oriented. The first is the quality of the top managers; Secondly, the quality of management personnel at all levels, especially quality management personnel; The third is the quality (skills) of all employees of the enterprise. Their quality determines the quality of the enterprise and also determines the quality of its products. If expressed in a functional relationship, it can be written as:

$$Q=f\times T\times M \tag{1.1}$$

In the formula :

Q – the quality of an enterprise or the quality of the work of its employees;

f – coefficient;

T – the technical level of the enterprise or the skill level of the enterprise staff;

M – the management level of the enterprise or the management ability and serious and responsible work attitude of the enterprise staff.

Professor Wang Dazhong (2007), the former president of Tsinghua University, once expounded the significance of the «people-oriented» principle in higher education.

1) First, we should attach importance to the human factor in the work of colleges and universities, correctly understand the value of human, and give play to the subjective and active role of human.

2) Second, the essence of school education is a humanistic process, which is centered on human teachers and students.

3) Third, among all resources, talent is the most important.

4) Fourthly, the active role of experts and professors should be played not only academically, but also in management, and teachers should be established as the core in the process of running schools.

With the rapid development of economy, society, science and technology, the world has entered an era of knowledge economy. The creation of social material wealth and the overall progress of society increasingly depend on the cultivation of human ability and quality, and talent has become the most precious resource. In order to adapt to the development trend of the era of knowledge economy, we must carry out the people-oriented management idea in every management work. As a special social organization for the purpose of cultivating high-quality talents, the management of colleges and universities needs to establish and implement the people-oriented management idea. It can be said that carrying out humanistic management is the urgent need to adapt to the needs of The Times to give full play to the functions of higher education and realize the goals of higher education.

The basic connotation of humanistic management. So-called humanistic management, mainly is relative to the management and put forward a kind of new management concept, its basic connotation, in order to realize person's full scale development as the ultimate goal, full respect for human dignity, personality characteristic and the main role, and earnestly protect everyone's interests, to everyone's health growth, fully realize its potential, to provide a good social environment and working rank Preface, fundamentally change the past kind of people as a tool to complete the task of the «material management». Humanistic management, stressed that whether managers are managers in spite of different social roles, but with the body of the equality of independent personality, need mutual respect, mutual understanding and mutual love, managers can't managers will be regarded as a kind of be let idle control object management is not merely a kind of active power control, it is a common activity of equal cooperation as the core.

The distinctive characteristic of humanistic management. Humanistic management has changed the past of that kind of person as the management idea and management mode, give full play to the managers and by managers from two aspects of

subjectivity and enthusiasm, will the power of the long-term management of popular one-way domination relationship into a kind of mutual cooperation and two-way communication channel, compared with the traditional management idea and the management pattern, has the following several distinctive features. First, humanistic management is a participative management. Humanistic management adhere to the people-centered principle, changed the past by managers and managers from the top to the bottom of the control relationship between the traditional management mode, for managers and by managers mutual cooperation and exchanges, and special advocate and encourage managers and serious thought to their own work, study conscientiously to involved in the management of a new type of management mode . In humanistic management, the manager is no longer a superior and commanding role, but an equal and cooperative partner role. The manager is no longer a passive subordinate role, but a positive subject personality to care for and participate in common management activities.

Humanistic management breaks the rigid boundaries and identity barriers between the manager and the managed, and regards management as a kind of cooperation, communication, service, autonomous management and democratic participation. Second, humanistic management is a kind of flexible management. According to the main rules and implementation force of management, we can divide the management idea into rigid management and flexible management. Rigid management refers to the rules and regulations, according to a written rely on organization authority for the routine management, emphasizes the authority of organization, organization system, which rely on command, supervision and control to implement the flexible management is based on the organization's Shared values and culture and spiritual atmosphere of personification management, emphasis on the cognition of organizational behavior norms, rules and regulations, understanding and internalization, mainly Rely on inspiration, guidance and support to implement management.

Humanistic management are not against the rigid management, but against will simply equated with rigid management, tries to implement personification management under the premise of standardization management, emphasizes the necessity of flexible management and the significance, emphasize the art of applying flexible management

closer and even eliminate the psychological distance between managers and by managers, to minimize the trace of mandatory power, to create equality, harmony, A friendly and cooperative management environment. Flexible management requires that both the manager and the managed should fully understand the various needs of people, learn to respect the subject personality and diversified personality of people, and complete the common task through mutual consultation, which is more in line with the basic purport of humanistic management. On the other hand, human-oriented management emphasizes more on flexible management, which is mainly flexible and combines hardness and softness. Third, humanistic management is a kind of flexible management. Human-oriented management especially emphasizes to respect and care for people, coordinate and organize people's activities in this spirit, and complete the management task. In people-oriented management, we respect and recognize the individual characteristics of each person, and do not consider it as a «trouble» in management, but a «advantage» that can be used in management. Humanistic management is a kind of full of personalized management concept and management mode, it according to the management objectives and management rules, hard to use personality characteristics of managers and by managers, give full play to the two aspects of the enthusiasm, initiative, to adapt to the specific circumstances, specific management task, so it is a flexible and personalized humanized management, therefore is also a kind of self management , independent management.

Humanistic management is a kind of management concept will managers and managers alike, it take person's full scale development as the fundamental goal, fully respect the person's main body personality and individual differences, management activity is regarded as a kind of motivate people's enthusiasm, creative, fully realize the potential of each person the personification of the process, a process of democratic participation of consultation, mutual understanding each other, and a kind of independent management The growth process of self-education.

First, humanistic management has great democratic function. Humanistic management to break the status barriers between managers and by managers and psychological distance, changed the traditional one-way governs relations as the core

management idea and the management pattern, will be a mandatory management activities into a full participation in the democratic activities, fully mobilize the initiative of the members and motivation, especially pay attention to by managers in the main role in the process of management. The entry point of humanistic management is democratic management. For the management of colleges and universities, only practise democratic management, to fully embody the host status of staff and students, to be effective guarantee fully exercise their power as masters of their homelands, staff and students to maximize arouse the enthusiasm of teachers and students staff involved in management provide opportunities and conditions, intrinsic motivation, enhance their work to enhance cohesion and centripetal force of the school. Humanistic management is not only a kind of democratic management, but also an important way to cultivate and bring up people's democratic quality and democratic participation ability. Democratic management is an important stage and part of the realization of democratic politics, and it plays an important role in democracy.

Second, humanistic management has a powerful self-motivation function. Humanistic management to fully consider the needs, desires, and individual character characteristic of organization members, to maintain and to mobilize the initiative and enthusiasm of supervisor and those reporting, to the growth and development of organization members participation has provided a broad space, will force management, passive management into autonomous management and participate in the management, make each organization members aware of their rights, obligations and social responsibilities, to members Self-development and self-motivation are organically integrated. Humanistic management focuses on self-actualization. People have a psychological mechanism of self-management, self-improvement and self-realization. When self-awareness develops to an advanced stage, people will have self-knowledge, correctly evaluate their own thoughts and behaviors, and actively adjust and control their behaviors according to their own motivation, needs and strength, so as to better implement them. The self-management of the staff is due to the spontaneous behavior of the managers fully respect and constantly encourage, and once this atmosphere is formed, it will maximize the release of people's potential energy, 'show people's

personality, make people always in a positive and creative working state. For both the manager and the managed, humanistic management has a powerful function of self-motivation.

Thirdly, humanistic management has profound educational function. Humanistic management especially emphasizes to respect and care for people, emphasizing that people are the purpose, personal dignity and respect for individual differences. As a management idea, humanistic management profoundly embodies the profound humanism tradition and the strong humanitarianism spirit. As a management mode, humanistic management is a kind of personalization management and personalized management, a kind of democratic management with full participation, and a kind of independent management and self-management. Therefore, humanistic management is not only an effective humanized management activity, but also a profound human education process, with imperceptible, profound and lasting educational function. Management education, emphasis on people-oriented management.

1.3. Modern theories of management of innovative processes in higher education institutions

Let's consider four main theories of innovative management of universities.

A historical review of principal-agent theory. From the perspective of ideological origin, principal-agent theory can be traced back to Adam Smith. In his book «the wealth of nations», argues that shares a manager in a company, rather than their wealth created by others, could not expect their alertness such as private partners to manage the enterprise, therefore, in the enterprise operation and management, more or less, negligence and wasteful to act is always popular. This actually involves the agency problem, revealing the potential inconsistency of interests between managers and investors. At the beginning of the 20th century, with the emergence of a large number of open companies, the principal-agent problem is more abrupt.

Therefore, In the modern Corporation and Private Property, Burleigh and Means (1937) bluntly stated that the increase of managers' power risks harming the interests of

the owners of capital. The continued separation of ownership and control, they argue, may allow managers to pillage companies. Since then, many economists have begun to study how principals can effectively control and supervise the behavior of agents, namely managers.

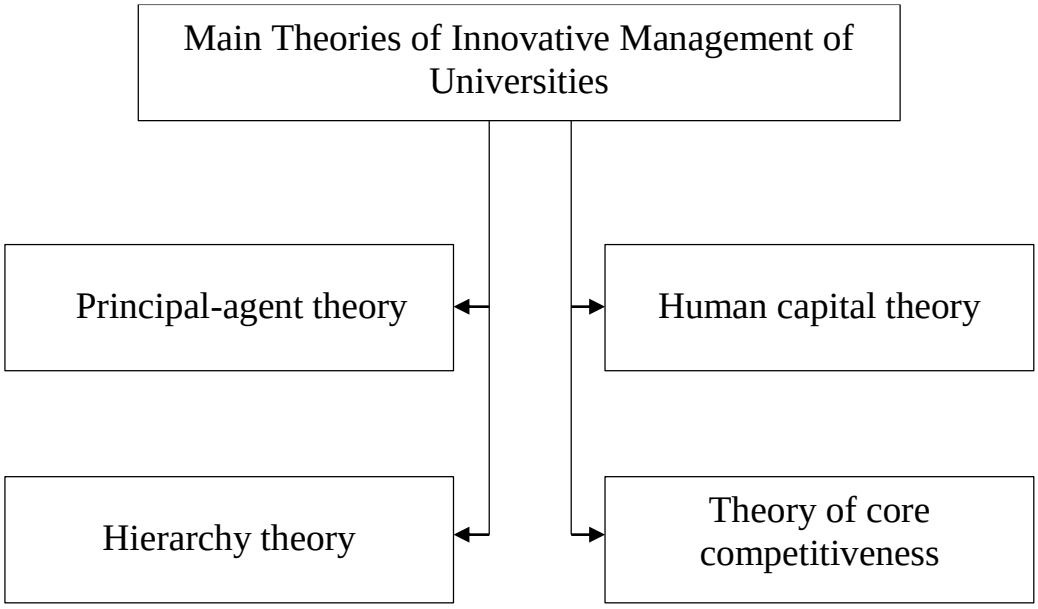

Figure 1.1 – Main theories of innovative management of universities

Source: formed by the author

About open public ownership of the company's main shortcoming, that is, produce in the separate of ownership and control agency problem, Jensen and McLean (1976) in its classical paper argues that managers have the incentive to privileges enjoyed by the consumption of salaries, have an incentive to take for himself and damage the interests of outside shareholders of investment and financing policy. Despite this agency problem, general financing theory always assumes that the maximization of shareholder wealth is the sole goal of a corporation, that is, the company is always managed in the best interest of all shareholders. The implicit premise is that market and institutional arrangements force agents not to deviate too far from value-maximizing behaviour. These constraining forces include competitive pressure in product market, manager market, capital market and corporate control market. Further, supervision of the manager's behavior can be implemented through the establishment of a board of directors (Farma and Jensen, 1983).

Similarly, executive compensation plans are arranged to provide additional incentives to align potential divergences of interest. Thus, there is a «package of internal and external monitoring instruments» that substitute for or complement each other and work together to impose constraints on managerial behaviour.

The essence of agency problem is the separation of ownership and control, which means that important decision-making agencies do not bear the behavioral consequences of their decisions, that is, the decision-making function and risk bearing function are actually separated. Of course, the degree of separation varies among different types of companies, such as open corporation and closed Corporation. Generally speaking, the former is always greater than the latter. In addition, due to the difference in the degree of separation of the two rights, the corporate governance structure of the two types of companies is also very different. For example, in terms of internal decision-making system, a closed company is suitable to combine decision management and decision control and control them in the hands of some agents. The basic reason is that in some small and uncomplicated organizations, Important expertise required for decision management and control is often concentrated in one or several agents to whom decision control and management can be efficiently assigned. Of course, in this state, the residual claimant may not be able to resist the agent's opportunistic behavior. This means there is an agency problem. A feasible solution to this problem is to allocate residual claims directly to these important decision-making bodies, replacing costly control measures that limit decision-making bodies' autonomy, thus maintaining a balance between autonomy and binding force of corporate decision-making bodies.

Different from closed companies, open companies must separate decision management and decision control in order to effectively control and solve agency problems. The main reasons are as follows:

1) First, the role of professional knowledge. Open the company as a complex organization, its basic characteristics are associated with different decision scattered professional knowledge in the organization, and decision-making management decentralization is granted rights to have relevant professional knowledge organization can reduce the cost of decision-making, and the resulting agency problems by separation

of decision management and decision control to reduce;

2) Second, the role of scattered residual claims. In large open companies, the residual claims scattered in many institutions, if all these institutions to participate in decision-making and control, the cost will be very large, the residual risk bearing and decision-making control must occur, the resulting agency problems, can define institutions of power (such as decision-making control and management phase separation) and controlled. Therefore, in these large open companies, the benefits from decentralized residual control and the benefits from the separation of decision-making function and residual risk taking are generally greater than the agency costs caused by these two situations.

3) Third, the role of the board of directors and the decision-making bureaucracy. In an open company, internal control is delegated to the board of directors by residual claimants. Residual claimants generally retain approval authority (through shares) on matters such as the selection of directors and auditors, mergers and new issues, and other management and decision-making functions are delegated to the board. Boards then delegate most of the decision-making management functions and many of the decision-making control functions to internal bodies, retaining only ultimate control over them, including approval of major policy proposals and the appointment of senior management managers. Such a hibernation mechanism in the decision-making process helps to prevent organizations at all levels of the company from taking actions that benefit themselves at the expense of the interests of the remaining claimants.

According to the research of Mork et al., there is such a relationship between ownership structure and enterprise performance: when the share ownership ratio of internal managers is between 0 and 5%, the enterprise's profitability begins to rise; When this ownership ratio rises further, to 25%, profitability begins to decline; As such ownership passed 25 per cent, profitability began to rise again. This suggests that, consistent with the incentive effect and reduce agency cost, the higher the ownership of the managers and big shareholder ownership was beneficial to the improvement of the performance, however, once this ownership ratio exceeds a certain limit, won almost complete control of the owner of the big, may be biased towards the use of enterprise to

meet its own rather than the interests of other shareholders. Thus, high ownership concentration, like excessive ownership dispersion, also breeds additional operating costs.

How to make a more comprehensive comparative evaluation of these corporate systems with different ownership structures? Morland argues that there is a constant external threat to substitute for poor performance management when the market mechanism is at work. This control of companies by market mechanisms facilitates the reallocation of scarce resources in the most productive way, which is not only in the optimal interests of shareholders, but also for the development of the economy as a whole. However, this system has at least three shortcomings:

- first, the threat of short-term behavior, that is, managers may pay too much attention to short-term favorable financial indicators and ignore the importance of basic investment to maintain the long-term performance of enterprises;
- second, in order to prevent the enterprise from being taken over, the current managers may adopt some unfriendly resistance and do not focus on the main task of effective management of the enterprise.
- third is empire-building, in which managers sometimes pursue excessive expansion of the size of the enterprise, thus sharply increasing the cost of doing business. In network-oriented systems, there are tight direct control mechanisms that work through the intervention of strategic investors such as major shareholders, so that management failures can be corrected within the organization without changing ownership.

At the same time, the agency conflict between shareholders and creditors is weakened by the internalization of the relationship. Of course, there are some drawbacks to such a system. In the absence of an active market for corporate control, certain management failures that cannot easily be corrected through direct oversight tend to persist.

Principal-agent theory attempts to analyze the following problems by establishing models: A participant, also known as the principal, the other participants, also known as the agent, in accordance with the interests of the former choice, but the client does not directly observed agent chose what action, but he can be observed in some of the other

variables, these variables by the agent of the action and other exogenous random factors decide together. The problem for the client is therefore how to use this observed information to reward and punish the agent in order to motivate him to choose the action that is in the best interest of the client. Once the principal-agent relationship is formed and the separation of ownership and control is formed, the objective function between the principal and the agent is usually not exactly the same, which will cause the conflict of interest between the principal and the agent, thus naturally causing the incentive incompatible problem. Further, since the consequences of the agent's actions are jointly determined by the agent's actions and some uncertain factors, the principal cannot directly observe the agent's actions and uncertain factors, but can only infer the agent's actions according to the observed consequences of the actions. So the principal about the agent's action or effort degree of information about the agent is asymmetric or is incomplete, as a result, the principal cannot accurately identify the agent action result of efforts by people or caused by uncertainty, in this way, the agent can be used to hide action but not completely bear all the consequences of their behavior. Thus, they may have the motivation to engage in actions that are high risk or damage the interests of the client, while the client has to take excessive risks, which leads to moral problems. Since agents always choose their actions according to the principle of maximizing their expected utility, in the pursuit of utility maximization, the principal needs to design an incentive mechanism to reasonably and optimally distribute the consequences of the agent's behavior between the principal and the agent, so that both parties share the risks. Make the agent's utility maximization goal and the principal's utility maximization goal consistent, realize the incentive compatibility between the two, induce the agent in the pursuit of their own interests at the same time to make the behavior choice in line with the principal's goal.

Incentive mechanism includes two closely related parts: the evaluation system for agent's behavior performance and the incentive system for agent (Fraja,1993). The evaluation system enables the principal to predict agent's behavior based on the observed behavior results. The incentive system is that the principal pays the agent according to the agent's goals achieved by the principal. Obviously, the effectiveness of the incentive

system depends on the accuracy of the evaluation system, the more accurate the evaluation system, the more effective the incentive system.

The results show that any additional information about the agent's actions, no matter how incomplete, can improve the welfare of both the agent and the principal. Conversely, the higher the degree of information asymmetry between principal and agent, the more difficult it is for principal to measure his efforts by the results of agent's actions, and market competition is considered by economists to be the main source of providing this additional information. Fama points out that market competition can produce information that constraints agent behavior, thus solving the incentive problem caused by the separation of ownership and control (Fama, 1980). The latest competition theory also believes (Vlicker,1995) that competition is the source of effective incentives, and the more fierce the market competition is, the more hard work will be the best choice for agents.

How to draw lessons from and use western principal-agent theory to analyze the reform of Chinese university management system is an exploratory topic in front of us. The author thinks that, firstly, we can use the general analysis method of principal-agent theory for reference. Secondly, we can use the general analytical framework and category of principal-agent theory for reference. Similar to the fact that there is no optimal corporate governance model applicable to all countries, due to the particularity of China's university system, there is no unified optimal university management model suitable for all universities. Therefore, we should not ignore the specific conditions of its application when learning from the experience of others.

There are two interrelated principal-agent relationships in the management of Chinese universities: one is between higher authorities and higher authorities. Due to information asymmetry between higher authorities and higher authorities, the interests of higher authorities have independent interests with the progress of reform, and the interests of higher authorities are inconsistent with those of higher authorities as agents. Second, there is a principal-agent relationship between the superior and the subordinate in the university. The university is the principal and the subordinate is the agent. The core of China's university management system reform is: on the one hand, the university

administrators should manage the universities well with the greatest autonomy; on the other hand, they should guarantee the interests of the country and effectively supervise and restrict the university administrators. At present, with the reform of university management system, the following situations appear: on the one hand, university administrators have full autonomy, but with the advancement of reform, the problem of insider control is increasingly prominent, but at the same time, government departments at all levels are still too much intervention in universities as parents and bosses. Therefore, the reform of Chinese university system is faced with the following problems: it is necessary to give university administrators full autonomy of operators, which can improve efficiency, but at the same time may bring about the internal control out of control; It is necessary for the state to supervise and control colleges and universities, but the special status of the state and its agents may make the supervision and control have strong administrative color and produce excessive intervention.

At present, there are a series of problems in the management system of colleges and universities, which are mainly reflected in the following aspects: in the aspect of incentive mechanism, the income of the agents of colleges and universities is not closely related to the performance of the schools. Income structure is not reasonable, low reputation salary; In terms of constraint mechanism, the owner constraint mechanism is vacant. Since the agent market similar to corporate governance structure does not exist, it is difficult to form effective competition constraints among agents.

The innovation of university management system is to establish and perfect effective incentive and restraint mechanism. Therefore, it is necessary to adhere to the unity of power, responsibility and interest, so as to mobilize the agent's enthusiasm to the maximum extent, and ensure the consistency of his behavioral goals with the client's requirements while giving play to his subjective initiative, so as to avoid and eliminate the agent's use of power and information advantage for personal gain and infringement of the interests of the relevant economic parties.

To this end, first, to establish a reward incentive mechanism. The reward incentive mechanism of colleges and universities consists of fixed salary, post allowance and bonus. As a relatively stable and reliable income, fixed salary plays a basic guarantee

role and meets the desire and demand of university staff to avoid risks, but the incentive effect of fixed salary is weak. Bonus has a certain risk, it is linked with the agent's «morality, ability, diligence, performance», has a strong incentive effect, but easy to lead to short-term behavior. If the post allowance can be matched with reasonable assessment, it can combine the advantages of fixed salary and bonus.

Second, control incentive. Corresponding to the principal with surplus claim, the agent should have business control, it can not only bring its status and other aspects of psychological satisfaction, but also make it have in-service privileges, enjoy post consumption, to the agent to bring formal remuneration incentives outside the material benefit satisfaction.

Third, reputation or honor incentive mechanism. Maslow believes that the demand of people has a multilayered, with the appropriate configuration in the incentive constraints mechanism of reputation or honor incentive mechanism, give agent reputation includes a strong sense of achievement in one's career, and by the success of career reputation and social honor and status, conform to the requirements of the client's goals and make the agent behavior.

Fourth, internal supervision and restraint mechanism. The legal person governance structure in modern company system usually establishes the mechanism of separation and balance of powers composed of shareholders' general meeting, board of directors, managers and board of supervisors. This mechanism reflects the requirements of owners and other stakeholders on senior managers and forms an organizational supervision and restraint mechanism for senior managers, which is manifested not only in legal constraints such as Company Law, but also in management constraints such as company charter and internal management system. Similarly, the innovation of university management system must be gradually established a comparatively complete internal supervision and restraint mechanism, through the education legislation and the establishment of perfect and feasible rules regulations within the superior between government and universities, colleges and universities between the various functional departments, between various functional departments and staff to establish a mutual separation and mutual checks and balances of power supervision and restraint

mechanism.

Fifth, competition constraint mechanism. Economics has shown that regulated and orderly competitive markets promote social welfare and efficiency. In order to solve the chronic problems in the management system of colleges and universities, the existence of effective competitive market is indispensable. To this end, it is necessary to establish a competitive market similar to the agent market. This kind of market should include internal market and external market two parts. Internal market is in a management unit within the formation of competition between agents, through the promotion of positions and necessary rewards and punishments to make agents better performance; External markets are agents competing with each other among management units. Obviously, the establishment of these two markets can not only form mutual constraints and constraints between agents, but also help to accurately evaluate the reputation and ability of agents.

The theory of hierarchical management is a branch of the classical organizational school. It was first proposed by The German sociologist and management thinker Max Weber. Through the analysis of the relationship between traditional authority, charismatic authority and legal-rational authority, Weber believes that the bureaucracy based on legal-rational is the most effective organizational model. In his book the social and economic organization theory, weber, from the Angle of sociology, analyzes the nature of the administrative organization and function, and puts forward some basic views of the hierarchical management theory, mainly include:

1) the division of labor and specialization, the establishment of the organization started with duties division, each department here has a number of jobs, every job should be professional;

2) Power stratification, organization according to the principle of hierarchy, there is a line of power from the top to the grassroots. Each level has different responsibilities and powers. This system is called the bureaucratic system;

3) Qualifications: The personnel of each position must be competent. The organization defines the qualifications and conditions for each position in the form of "law", as well as the standards and methods for the implementation of assessment. Bureaucracy management is the objective requirement of industrial and commercial

economic development after the industrial revolution. This rational organization based on responsibility system and centered on power has a very positive significance to improve the work efficiency of administrative organizations.

Weber's bureaucracy theory has been widely used because of its rationality and unique advantages, but at the same time it has been criticized and questioned because of its imperfection. Hoy Miskel, another researcher of bureaucracy theory, has proposed the characteristics of the ideal «bureaucracy» (Table 1.1) (Hoy, Miskel, 1982, P81-83).

Table 1.1 – The ideal characteristics of Hierarchical system of Miskel

① Hierarchical Authority Structure	② The upper level manages the lower level, and each member has only one direct supervisor.
③Division of Labor \ Specialization	4 «Division of labor» accelerates "specialization" and improves efficiency.
⑤Impersonal Orientation	⑥Act in accordance with the law, do not interfere with personal likes and dislikes, and show rationality.
⑦ Rules and Regulations	⑧ There are written files to record all activities, decisions, rules, etc., for reference at any time, so that the organization has coherence.
⑨ Career Orientation	⑩ Hiring based on qualifications, guaranteed tenure, promotion based on years of service or contribution.
⑪ Separation of Administration from Ownership	⑫ To make the executive more rational use of power, and power should be the office itself, not private individuals.

Source: prepared by the author based on Hoy, Miskel, 1982, P81-83

By comparing the ideal hierarchical management system with the current university administrative management system, it is found that there are gaps in the roles of administrative personnel, work starting point, organizational structure setting, rules and regulations, division of labor mode, communication mechanism, evaluation and

assessment, understanding of work objects and evaluation standards (see Table 1.2)

Table 1.2 – The comparison of existing administrative system and the ideal system

Comparative	Existing administrative	Ideal hierarchical management
Role orientation	University main body, rule maker, resource distributor	Service provider, academic partner
Starting point of work	Job tasks, responsibilities	Meet the needs of teachers and students
Organizational structure	Pyramid hierarchy	Flat structure
Rules and regulations	Higher departments centralized formulation	The formulation process is scientific, democratic and academic
Division mode	Division of labor without cooperation	Cooperation under division of labor, division of labor under cooperation
Communication mechanism	Unidirectional, command	Multi-directional, interactive
Evaluation and examination	Direct superior evaluation	Teacher and student evaluation, teacher and student satisfaction as the standard
For the object of work (academic Personnel)	Command issue object, task assignment object, and command object	Negotiator and service object
Evaluation criteria	Task-oriented	Management efficiency and performance

Source: formed by the author

Although the bureaucratic system has certain deficiencies and even «counter-effects», the principles of «hierarchical stratification», «impersonal», «professional division of labor» and «regulation management» have still become the golden rules that continue to be used in organizational management. The establishment of the bureaucratic system makes the management of the organization more rapid, convenient and efficient. The pure bureaucratic system is established according to rational calculation and has predictability. Bureaucracy provides the strictest authority structure for the transmission of instructions, so that the issuing of instructions can be well «calculated» (Robert Danhart 2002). Officially based on the above advantages of bureaucracy, this organizational management model has gradually been applied to educational

organizations. The first person who put forward the view that Weber's bureaucracy theory is applicable to school organization is educational management scientist Marcos Abbott.

Lin Jie once pointed out that although the concept of organization has become increasingly complex and the academic research on bureaucracy has continued to deepen, Weber's classic views on bureaucracy are still constantly invoked by modern scholars, including: Bureaucracy is a large-scale organization, bureaucracy has to perform certain social functions, division of labor among professionals, bureaucracy provides maximum security for employees and their families, bureaucracy is maintained by a series of rules and regulations, there is a hierarchical relationship of authority in bureaucracy, and bureaucracy is impersonal management (Lin Jie 2009).

Hierarchical logical model of university organization. Based on the analysis of the logic and bureaucracy of university administration, the author constructs the logic model of bureaucracy of university administration (see figure 1.2).

The regulation of university administration needs to go through two stages: administrative administration-management efficiency and administrative efficiency-academic performance. First of all, it is necessary to make university administration efficient and innovative according to the four aspects of bureaucracy logic (following rules, specialization, impersonal management and hierarchical control). Secondly, through the participation of effective academic forces, the right to speak of academic power is respected in management, and the internal organizational characteristics of the university are observed as the basis for the improvement of university administration from management efficiency to academic performance.

The traditional bureaucracy emphasizes rationality and order, pursues rationality, productivity and efficiency, and ignores the fundamental pursuit of humanity and wisdom in universities. To reform university administration from the root of system, an important premise is to observe the academic law. The three functions of education determine its inherent law, and administrative management should obey its law, and innovation should not be emphasized blindly. The university needs a peaceful academic environment, the administration should take service as the core, and give academic

power full freedom.

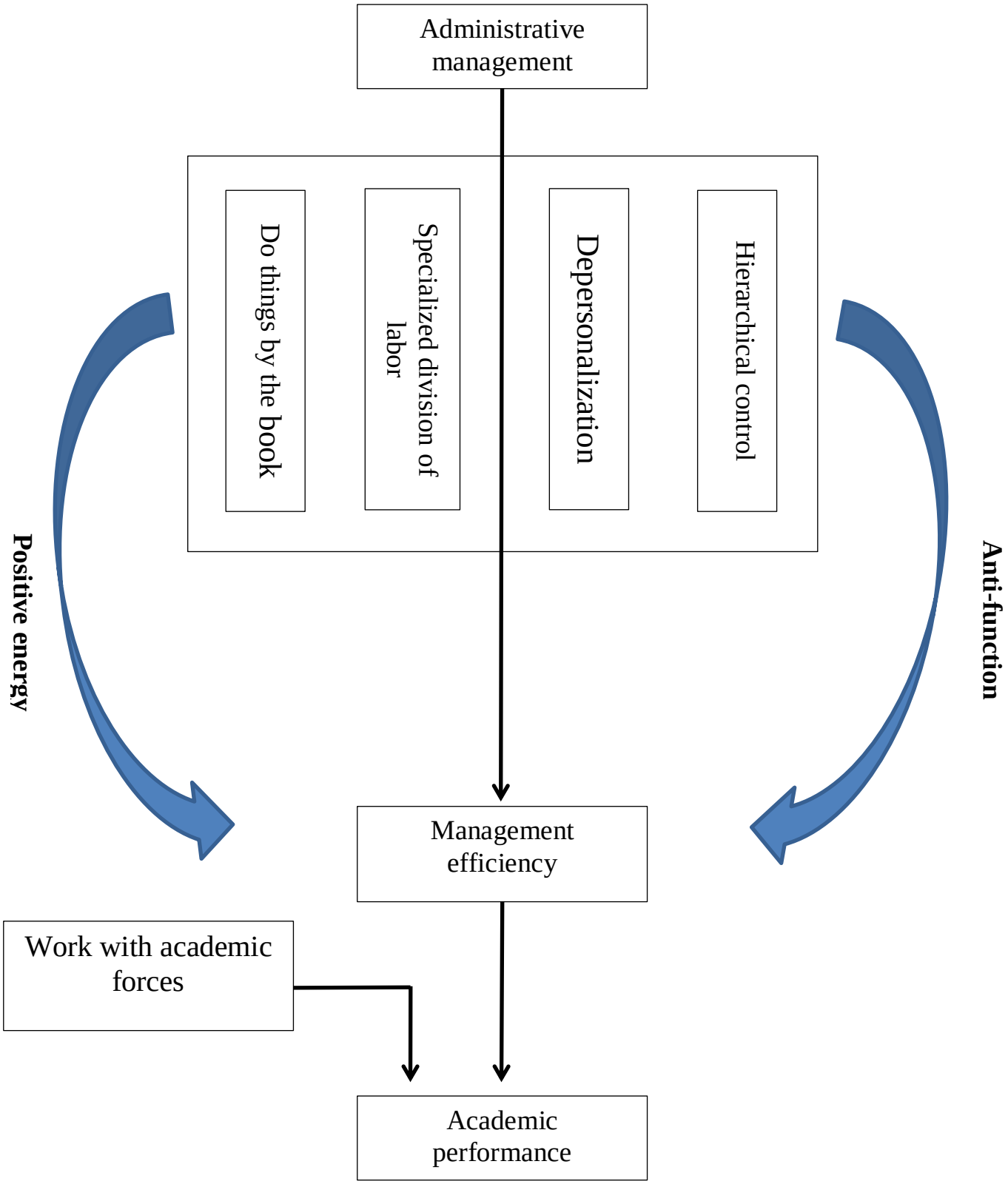

Figure1.2 – The hierarchical logic model of university administration

Source: formed by the author

Therefore, the reform of the administrative management system must conform to the characteristics of the university and follow the law of university education. The dispute on the application of hierarchy theory in educational management. From the 1960s, American educational management scientists and school organization researchers began to try to explain the problems of school organization by using the concept of hierarchical organization.

Since then, the hierarchy theory has exerted a great influence on the establishment of the internal management mode of colleges and universities. Educational management scientists and school organization researchers have three different views on the applicability of hierarchy theory in educational management.

Marcos Abbott, an educational management scientist, first proposed the view that Weber's hierarchy theory is applicable to school organization. In his 1969 book Hierarchical Barriers to Innovation in Educational Organizations, he argued that schools «can truly be described as highly developed bureaucratic organizations».

Educational sociologist Charles Bidwell disagrees. In his book School as A Formal Organization, he pointed out that schools are characterized by «structural looseness, which is associated with bureaucratic organizations in a special form». He thought education organization is not purely a hierarchical organization, because although school performance in several aspects given characteristics of the organization, including the function of labor division, rank order of scheduled position, operations carried out in accordance with the rules, and so on, but education organization and has the characteristics of loose structure, so the education organizations cannot implement the weber's thoughts without reservation. Ronald Kerwin further points out that there are two sources of power in educational organizations, one is bureaucratic power, the other is academic power or professional power. Since then, this duality in educational organizations has been widely recognized.

The third opinion holds that the situation of educational organizations is very complicated, and the level of bureaucracy of each organization in the education system is related to its level, task, nature, personnel composition, and even the management behavior of school leaders. Therefore, various educational organizations should apply

the bureaucracy theory based on their own actual situation.

Although people have different views on the hierarchy theory, it does have a real impact on educational management: many Western countries have established a management system that connects the top and the bottom with a clear division of labor in the education system; The state entrusts educational organizations at all levels with clear responsibilities and powers through laws, regulations and policies. In the school has established a perfect administrative management organization network, the functional departments are well organized, the division of labor is clear, there are standard working procedures; Leaders at all levels should often assess the work efficiency of their subordinates, and decide their promotion according to their ability and achievements, etc. Should admit, weber, and then be incorporated into the thought of some sociologists education management, education management research produced the extremely important influence on the way of thinking, greatly broaden the horizons of education management, make people realize that the school should be as complicated organization to study, after the '60 s, Europe and the United States education increasing showed strong interest in hierarchical organization, It further brings educational researchers into more direct contact with sociologists, and at the same time guides educators closer to the research track of general management. The study of hierarchical organization also shifts the focus of educational management thinking away from the informal aspects of interpersonal relationships and organizational life and emphasizes the importance of understanding the formal organizational nature of schools. In this process, it makes the researchers of educational management more aware of the problems of power, general rules and organizational dysfunction.

The research on hierarchical organization does provide a new strategic idea for higher education management to understand the structural relations and power relations within formal organizations like colleges and universities, which has certain reference significance for the current research on higher education management theory and the innovation of higher education management system mode.Since its inception, universities have been places for scholars to pursue knowledge and search for truth, rather than organizations of administrative management. Zhang Weiying (2004), a

professor at Peking University, has analyzed that university administration is a derivative tool of knowledge dissemination and creation, which is derived rather than original demand. When students come to school, administrative services are not what they need. The administrative work of the university is to serve and escort the advancement of academic affairs, and the pursuit of academic development is the real purpose of running a school. Therefore, the author believes that the purpose of standardizing university administration should not only be to improve work efficiency, but also to promote the realization of university running goals and enhance academic production and reputation. The power within the university has the characteristics of diversification, and the administrative power is not the only one. Only when administrative power plays its role together with academic power can the value of administrative management be truly reflected. Only by serving the needs of the university's community of scholars and scientists from an auxiliary position and adapting to their various quirks can the efficiency of academic research be improved (Kosse 2001). Therefore, the focus of university administration is not leadership and management, but service and security. The establishment of effective administrative management system can help to reduce the cost of running a school, reduce the waste of resources, and rationally allocate human, financial and material resources. While improving the work efficiency of all departments, it ensures the normal operation of the school and maximizes the benefits of running the school. The pluralistic power structure within the university is an important feature that distinguishes the university from other political and economic organizations. Administrative power and academic power are both indispensable, but in the final analysis, academic power is the main internal force that dominates the development of universities, so the development of academic performance is also fundamental.

Improving management efficiency and reducing organization cost are the starting point of innovation of internal management system in colleges and universities. The biggest characteristic of hierarchy theory is that it attaches importance to management efficiency. According to Robert Merton, an American educational management expert, the main merit of bureaucracy is its technical efficiency, which is manifested by its emphasis on precision, rapidity, expert control, continuity, processing authority, and

optimal return on input. The structure of hierarchical organization completely eliminates all kinds of personal relationships and irrational needs. The hierarchy theory holds that the process of school education is rational, so the human and material resources of colleges and universities should be properly used in an effective way to maximize the benefits of the limited educational resources. In fact, the efficiency of educational organization is a neglected aspect of higher education management research in China. Undoubtedly, improving the work efficiency of educational administrative organization, the work efficiency of university administration and the work efficiency of teachers plays a vital role in the development and improvement of higher education in China.

The management of higher education should have distinct levels and reasonable span. The hierarchy theory emphasizes the distinct management levels, and the division of labor is different with the different levels of higher education management. Therefore, not only the educational administrative departments, but also the various management levels of colleges and universities, should have a clear and reasonable distribution of duties, responsibilities and rights, to straighten out the relationship; According to the law, what should be managed at all levels, to what extent, how to manage, and strive to overcome the blindness and randomness of management, so as to improve the effectiveness of management, so as to improve the quality and efficiency of running schools. At the same time, the level of the higher education management must also pay attention to the problem, a reasonable span too small will span over the ability of managers, appear power out of control phenomenon, and excessive level will command is ineffective, information transmission slowly, therefore, should consider the development of school size, subject distribution and the humanities, identify a specific management mode, form an organizational system with effective macro control and effective micro coordination.

Division of labor and integration are the most basic contradictions in management practice. According to the hierarchy theory, a university is a complex organization with an obvious hierarchy structure, that is, a university is composed of the president, administrative staff, teachers, students and other relevant personnel. They have a strict division of labor between each other, there are significant differences in status, role and

responsibility. The degree of refinement and rationalization of the division of labor is the most important determinant of the efficiency of human resources utilization in higher education, and also the most important index to determine whether an educational system structure is scientific. However, we also find that with the improvement of division of labor and the deepening of disciplinary differentiation, as a whole, it is difficult for colleges and universities to make satisfactory progress in all disciplinary fields, so they can only choose some advantageous disciplines to develop. Therefore, it is necessary to integrate the human resources of colleges and universities while dividing the labor. Modern management studies show that with the refinement of the division of labor, the difficulty of system integration is increasing, and the integration cost is also on the rise. One of the important goals of internal management in higher education is to determine the specific boundary of division of labor and integration according to the difference of organizational scale, so as to achieve the maximum benefit of educational management.

The theory of human capital arose in the late 1950s and early 1960s, and still dominates the economic theories of education in the world, and influences the policies of educational development in various countries, especially the formulation of educational investment policies. Human capital theory mainly uses the cost-benefit analysis method to analyze the personal rate of return and social rate of return of education cost, and then fully affirms the economic value of education, and expounds the positive correlation between education development and economic development. Theodore W. Schulz, the founder of human capital theory, also widely used this theory to discuss the problems of higher education, and had a very wide influence in practice. There is a basic point in Schulz's human capital theory, that is, the higher the level of education a person receives, the greater the personal and social benefits will be. Therefore, it can be inferred that the economic benefits of higher education are greater than those of secondary education, and the economic benefits of secondary education are greater than those of primary education. At the same time, he also believes that the economic value of higher education is much higher than that of other education because it has three functions: talent discovery, teaching and research. However, the research on

the economic value of higher education is usually too much on the research of teaching activities, although the value of research has been recognized, but not enough attention, as for the value of talent discovery is seriously ignored. Schultz's research on the economic value of higher education and education as a whole is unprecedented in both depth and breadth. The great development of world higher education in the 1960s and 1970s, in addition to the influence of economic, political, cultural and demographic factors, the theory of human capital has been deeply rooted in the people's mind, undoubtedly played a role of promoting.

However, since the end of 1960s and the beginning of 1970s, with the emergence of a series of educational problems and the social problems brought by them, the human capital theory has been severely challenged and began to be criticized from many aspects. From the point of education issues, «diploma», «excessive» education, «education waste», «college graduates unemployment» plagued by many countries (especially developed countries), although the problem is not completely caused by education itself, but the emergence of these problems is to is under hot's theory of human capital poured a pot of cold water. At the same time, screening theory and socialization theory came into being one after another, criticizing human capital theory from different aspects, and people began to doubt the view that education development is positively correlated with economic development and social development. A large number of survey statistics show that in most countries, the private return rate and social return rate of primary, secondary and higher education are: primary education is greater than secondary education; Secondary education is greater than higher education, especially in developing countries.

Therefore, it is of great significance for developing countries or regions with relatively backward development of primary and secondary education to formulate education development strategies. Others on the economic development in the world in recent years is rapid Asian «tigers» of the relationship between economic development and higher education research results found that their economic development indeed there is a close relationship with its education development, but in terms of the contribution rate of education at all levels, some economists measurement result is

through various methods, It is an indisputable fact that the expansion of higher education contributes far less to economic growth than basic education. Henry Levin, a contemporary American education economist, studied the relationship between the development of high-tech and the change of employment and education in the United States from the 1960s to the early 1990s and found that the actual situation of employment changes brought by technological development was contrary to the popular view, and most of the newly increased employment was not high-tech occupations.

The technologies already in use do not require workers with more sophisticated skills. Based on this, he believes that the development of Education in the United States should not only focus on the cultivation of advanced technical personnel, but should pay more attention to the cultivation of good citizens and efficient generalist education, especially through improving the quality of primary and secondary education, and generally improve the overall quality of workers. Even deny that there is a causal relationship between education level and economic level, but also between people through the national economic development and the comparison of the development of higher education, criticized that the faster development of higher education, the higher economic growth rate will inevitably point of view, and in the early 80 s, director of the institute for international education planning, Michel DE Beauvais, points out that the view that education is the major factor of economic growth, which was generally accepted in 1960s, has aroused wide controversy now. He also noted that the negative impact of education on economic and social development had been emphasized in almost all countries and international conferences at that time.

Other scholars argue that the value of education as an investment in human productivity was virtually unquestioned in the early 1960s, but by the early 1970s the belief in education as a panacea for development had entered a period of doubt. Since the early 1980s, although the world's higher education has continued to develop, its focus has shifted from quantity growth to quality improvement. Compared with the 1960s, people's concept of educational development has obviously changed. The theory of human capital is particularly influential, but not as important as it once was in people's minds.

From the experience of human capital theory, we can get such enlightenment: education plays a role in social development, and it is very significant, but the play of this role is based on the degree of education and social needs as a prerequisite. When the products provided by higher education cannot meet or exceed the needs of society, the role of education (including higher education) in social development is often limited. In other words, we can neither deny the great role of education in social development, nor regard education as omnipotent. Some scholars think that the research on educational function still lingers in the normative stage of what education «should» or «must» have, or in the speculative stage of education serving not only social development but also human's overall development. When discussing the positive function of education, the majority of scholars did not make due restrictions, that is, they did not explain the conditions that the positive function of education must be released or developed, and they did not explain the positive function of education has its limits.

Therefore, the experience of human capital theory has great significance for us to discuss the function of universities and the development direction of universities. The understanding of social value, or is the important basis to determine the function of colleges and universities, fully aware of the differences between human capital requirements and dynamic, the reasonable of functions in colleges and universities and the development of higher education policy, reasonably determine the scale of professional development is very necessary, for the healthy development of the whole education system and the whole society, is also beneficial.

Core competence, also known as core competence, is an important branch of strategic management theory, which was first proposed by American scholars C.K.Prahalad and Gary Hammel in 1990. They believe that «core competitiveness» is a collection of skills and competitiveness, a «disorderly accumulation of learning» that contributes to the success of enterprise competition, and a copy of potential resources that constitute the advantages of enterprise organization. Core competitiveness theory completely changed in the 70 s before the advent of «target F diameter method» of traditional ideas of management, the management decided to act before questioned whether should formulate strategy, think management action logic should be «don't

development plan first and then get ability, on the contrary, should first establish ability, And then encourage the development of programs to develop those capabilities».

JayB. Babey, a famous American scholar, further believes that core competitiveness, as an important resource, has three significant characteristics: value, scarcity and difficulty to imitate. Therefore, core competitiveness is complex and difficult to understand, which produces another deep-seated problem in enterprise management, namely the management problem in the formation of core competitiveness. Clearly, managers need to be able to identify these capabilities in specific management practices and make decisions about how to develop and extend them.

WesDov absorbed many concepts of core competitiveness theory, and on the basis of identifying the difficulties encountered in the implementation of core competitiveness management, proposed five key processes to help solve these problems: the development process of competitiveness, the diffusion process, the concentration process, the deepening process and the renewal process. Dodds believes that in the formation of core competitiveness, we must deal with the relationship between «natural formation» and «acquired regeneration».

On the one hand, the formation of core competitiveness follows a natural track. Any enterprise must have certain competitiveness if it wants to survive. It can also develop this competitiveness through «learning by doing» without management intervention. On the other hand, proper management can make the formation of core competitiveness more efficient, through business process reengineering, quality management, vocational training and a series of management means can effectively accelerate the development of competitiveness.

Application of core Competence theory in internal management of colleges and universities. It is one of the ultimate goals of the development of higher education to train qualified talents needed by the society and contribute good scientific research achievements, while competitive advantage is the main form of realizing the development goals of colleges and universities. Here, the rational allocation and effective use of educational resources are the basis and premise of forming competitiveness, while the cultivation of core competence is the key to forming

competitiveness, and the two complement and promote each other.

In terms of the efficiency of resource allocation, the planned economy system to form education resource allocation and use of the principle has exposed to more and more disadvantages, dispersion, low teaching quality, education investment scale of some problems existed in different degrees affect the further development of higher education reform, restricting the full play of the enthusiasm and creativity of running colleges and universities. At the same time, in the possession and use of resources, the closed and backward concept of «for my own use» and «equal distribution» is still very popular, which seriously restricts the socialization of educational resources use. Therefore, it is necessary to follow the law of market economy and carry out the principle of giving priority to benefit and considering fairness.

In terms of the cultivation of core competitiveness, on the one hand, we should emphasize the role of «survival of the fittest» mechanism, ensure that the disciplines and specialties urgently needed by economic construction are «satisfied», support a group of promising new disciplines and specialties to form scale as soon as possible, so that the existing colleges and universities form their own characteristics at different levels and in different types. On the other hand, we should break through the concept of «static value», focus on the dynamic effect of resources, and devote ourselves to building core competencies that can help improve the competitiveness of colleges and universities, such as environmental atmosphere, cultural tradition and organizational mechanism with its own characteristics, and stimulate the team spirit of employees through management and practice cultivated by core competencies. Promote the reform of university development from development - diffusion - concentration - deepening - renewal.

Of course, schools are not enterprises, talent training is different from material production, the management of educational resources cannot copy the set of management methods of production and investment, put teaching and scientific research in the center of the reform of the internal management system of colleges and universities. At present, great progress has been made in the reform of the management system in colleges and universities, but the focus of the reform is mainly on the division of functions and system integration in colleges and universities, while the attention to

teaching and scientific research is very insufficient. Therefore, when cultivating the core competitiveness, we should focus on teaching, scientific research and promotion and make great efforts to improve the quality of education and more scientific research achievements.

Conclusion to the Chapter 1

1. From the macro operation mechanism of higher education management, the management models of various countries have their own traditions and characteristics, but generally have strong adaptability to market system. The privatization and competitive efficiency of higher education are also important contents of the study. The following aspects of research in this field are more eye-catching. First, research on the relationship between universities, enterprises and society. Another example is the research on management evaluation of colleges and universities. There are two main problems: one is for whom evaluation is made, whether it is for investors, managers, political leaders or customer groups; the second question is what problems to solve, whether to improve the quality of education, reduce costs or improve work performance.

2. The research on the reform of internal management system in colleges and universities in China mainly follows several ideas. The first is the study on the deficiency, which mainly analyzes the conditions and preparations needed for deepening the reform of internal management system, especially the preparation for thinking and social environment. The analysis of the meaning function, necessity and urgency of the reform of the internal management system of colleges and universities occupies a considerable proportion in the so-called research on the deficiency. The second is the research on the target system of the reform of the internal management system in Chinese universities. Establishing a democratic school running system that relies on the democratic participation, democratic decision-making, democratic management and democratic supervision of the staff; construction of high-quality teachers and management team, improve the employment, assessment and reward and punishment system, improve the overall quality of the staff. Some scholars believe that the reform goal of the internal management system of Chinese colleges and universities is to establish five mechanisms,

that is, the organization mechanism with efficient operation, the management mechanism with self-restraint, the employment mechanism with incentive competition, the distribution mechanism with strong guarantee and the supervision mechanism with sensitive control.

3. The focus of the reform of the internal management system or specific issues of the thematic research. According to the stage and situation of the reform of the internal management system of Chinese colleges and universities, the educational circle has focused on the reform of the employment system, the reform of the wage distribution system, the reform of the socialization of logistics, the guarantee of the flow of talents and the service system. In recent years, experts and leaders of colleges and universities around the country have also put forward specific methods and ideas for deepening the reform of the internal management system according to the reform practice of their own units.

4. It has played an active role in promoting the reform of internal management system in universities of our country. However, these studies are still lacking, so it is difficult to meet the requirements of the new situation of the internal management system reform of Chinese universities. Specifically speaking, there are mainly the following shortcomings: first, there are more on the matter, less systematic theoretical research; second, more empirical summary, less prospective research; third, there are more principled studies, less structural studies, and less research on institutional innovation of teaching science. Fourth, there are more single-discipline studies and less comprehensive studies.

5. Based on the historical review and performance analysis of the traditional management mode of colleges and universities in the new environment of university development, the research will systematically study the reform of the management system of colleges and universities, especially the innovation of the internal management mode of colleges and universities under the background of marketization, networking and globalization by comprehensively applying the background.

CHAPTER. 2. ANALYSIS OF CURRENT SITUATION OF MANAGEMENT OF INNOVATIVE PROCESSES IN HIGHER EDUCATION INSTITUTIONS

3.1. Features of state financial support for the development and innovation management of higher education institutions: regional aspect

Government investment in higher education (after this referred to as GFHE) is governments' investment at all levels in higher education institutions. It is the financial support provided by the state for colleges and universities. It provides essential guarantee for the comprehensive, coordinated, and sustainable development of higher education in material terms. Since China implemented the popularization policy of higher education, the spatial structure of higher education has changed significantly. First of all, from the perspective of the government, with the rapid development of China's economy in recent years and the implementation of the «world-class universities» (after this referred to as «double first-class») university construction strategy from 2015, the government continues to increase investment in higher education. Still, the allocation of higher education resources in various areas is unreasonable, and the investment is insufficient.

The problem of low investment efficiency still exists, which leads to the imbalance of regional economic development to a certain extent; secondly, from the perspective of higher education institutions, China's higher education institutions lack an effective management mechanism until now in the use of higher education investment. Many institutions cannot take full advantage of government investment to develop and cultivate their advantageous disciplines, resulting in an improper use of education funds and low input-output efficiency, which seriously restricts the long-term development of colleges and universities. Therefore, given the above problems, it is of extremely significance to further analysis of GFHE and performance evaluation management.

This study puts forward the following four hypotheses:

H1: The increase of the GFHE scale in China is related to investment performance.

H2: The performance of GFHE in China varies among different areas.

H3: The performance of GFHE in different provinces in the same area of China is also uneven.

H4: China's GFHE performance may be affected by factors such as total population size, Engel's coefficient, GDP per capita, urbanization process, and the proportion of tertiary industry output value.

The Data Envelopment Analysis (DEA) is used to measure the performance of GFHE, and the comprehensive efficiency is divided into scale efficiency and pure technical efficiency through its variable return to scale DEA. The Decision Making Unites (DMU) efficiency value obtained by DEA is between 0-1, thus further analyzing the impact of different economic and social factors on GFHE performance in other areas. According to the impact of different economic and social factors on regional GFHE performance and combined with the existing literature, this paper uses the panel Tobit regression model for empirical analysis.

To measure and analyze the GFHE performance level comprehensively and accurately, this paper selected five indicators as input indicators, including educational fund allocation, infrastructure allocation, scientific research allocation, other funding allocation, and additional funding for education, based on the input-output analysis method. The output indexes include the number of graduate students, the number of papers published by teachers and students, the number of invention patents and fixed assets. The input and output indicators of the above GFHE are dimensionless, and the dimensionless treatment formula is:

$$ki=\frac{x_i - \min x_i}{\max x_i - \min x_i}\ ,\ i=1,2,3,\ \ldots\ldots n \qquad (2.1)$$

Where, ki represents the standardized value of index xi, ki [0,1]; Min xi represents the minimum value of index xi in the overall evaluation object; Max xi represents the maximum value of index xi in the whole evaluation object.

The basic idea of indicator weighting is to determine the objective weight of indicators, which is based on two basic concepts. One is contrast strength. It represents

the value difference between each evaluation scheme of the same index in the form of standard deviation. That is, the size of the standardized difference indicates the size of the value difference between schemes within the same index. The larger the standard difference, the larger the value difference between schemes. The second is the conflict between evaluation indicators. The conflict between indicators is based on the correlation between indicators. If there is a strong positive correlation between the two indicators, it shows that the conflict between the two indicators is low. The quantitative indicator of the conflict between the j-th indicator and other indicators is $\sum_{t=1}^{n}$（1-rtj）, rtj is the correlation coefficient between the evaluation indexes t and j, and the objective weight of each index is determined by the comprehensive measurement of contrast intensity and conflict. Let Cj represent the amount of information contained in the j-th evaluation index, then Cj can be expressed as:

$$Cj = sj \sum_{t=1}^{n} （1\text{-}rtj），j=1,2,3，…，n \tag{2.2}$$

The greater Cj, the greater the amount of information contained in the j-th evaluation index, and the greater the relative importance of the index, so the objective weight of the j-th indicator should be:

$$Wj = \frac{C_j}{\sum_{j=1}^{n} Cj}，j=1，1,2,3，…，n \tag{2.3}$$

The study further uses DEAP 2.1 and STATA software to empirically analyze the GFHE performance of 29 provinces in China from 2008 to 2020. The data were obtained from the website of The National Bureau of Statistics of China, China Educational Expenditure Statistical Yearbook and China Education Statistical Yearbook, etc. Qinghai, Hainan, China Hongkong, China Macao, and China Taiwan’s five areas lack data due to the lack of education supplemental funds, so this article is eliminated. Some missing data in other provinces are estimated by the linear estimation method.

The GFHE funds data are collected from the statistical yearbook of China's education funds by selecting five evaluation indicators: education cost investment, infrastructure investment, scientific research funds investment, other funds investment, and education additional investment. As shown in Figure 2.1, the average GFHE funds of each area showed an overall steady growth trend from 2008 to 2020. The average government investment per Province in the eastern part increased from RMB 6.092 billion in 2008 to RMB 30.796 billion in 2020, an increase of more than four times, with an average growth rate of 14.79%.

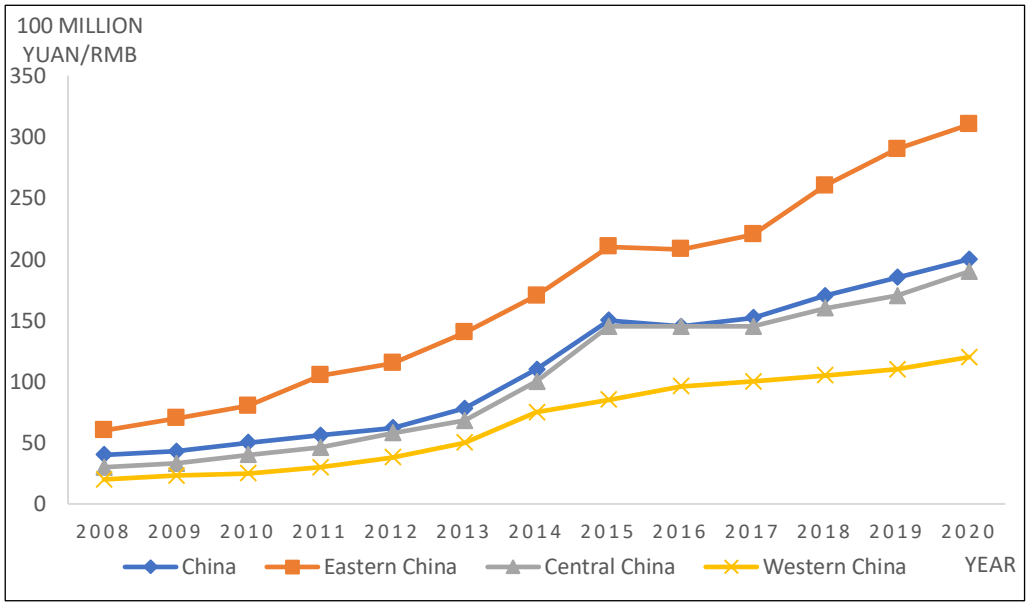

Figure 2.1 – Average GFHE scale of each area in China by province (100 million yuan/RMB)

Source: formed by the author

The average provincial GFHE expenditure in Central China increased from 2.959 billion yuan in 2008 to 19.651 billion yuan in 2020, an increase of 5.5 times, with an average growth rate of 18.22%; The average provincial GFHE expenditure in western China increased from RMB 1.554 billion in 2008 to RMB 11.403 billion in 2020, an increase of 6.3 times, with an average growth rate of 18.80%; The average provincial GFHE expenditure in China increased from RMB 3.524 billion in 2008 to RMB 20.616 billion in 2020, an increase of 4.8 times, with an average growth rate of 16.38%. From

the perspective of interprovincial comparison, taking 2020 as an example, in eastern China, Beijing has the highest GFHE fund of 70.696 billion yuan, and Fujian has the lowest GFHE fund of 15.672 billion yuan; In central China, Hubei Province has the highest GFHE fund of 30.215 billion yuan, and Shanxi Province has the lowest GFHE fund of 11.098 billion yuan; In western China, Shaanxi Province has the highest GFHE fund of 25.225 billion yuan, and Tibet Autonomous area has the lowest GFHE fund of 1.719 billion yuan. The GFHE funds in eastern China are significantly higher than those in the central and western areas. The GFHE funds in central China are higher than those in the west area, and the GFHE level in central China is not much different from that in the whole country. Overall, there are significant differences in the scale of GFHE between the eastern and the western of China, and the difference has no narrowing trend (Figure 2.1).

GFHE performance analysis of eastern, central, and western China.

1) Comparative analysis of GFHE performance in China. From 2008 to 2020, China's GFHE performance generally fluctuated and increased slightly, but maintained a high-efficiency level. From a regional perspective, there is a significant gap in GFHE performance among the three areas of eastern, central, and western China.

2) Performance type analysis of GFHE in China. It can be seen from Table 2.1 that the comprehensive efficiency of GFHE in individual provinces reaches more than 0.95. There are 3 in the eastern region, 4 in the central area and 2 in the western region. This shows that the higher education funding allocation of the above provinces has reached a high level, and GFHE funds have been well utilized.

According to the statistics of the average value level of GFHE performance (comprehensive efficiency) of each province from 2008 to 2020 in table 1, the GFHE performance of each province is divided into three types: class I area «low efficiency» (performance value < 0.85), class II area «medium efficiency» (0.95 > performance value ≥ 0.85) and class III area «high efficiency» (performance value ≥ 0.95). Among the 29 provinces, there are 9 «low efficiency» in class I areas, 11 «medium efficiency» in class II areas, and 9 «high efficiency» in class III areas (table 2.2).

Table 2.1 – Average performance of government funding in higher education of each province from 2008 to 2020

eastern China	average	central China	average	western China	average
Beijing	0.871	Shanxi	0.928	Inner Mongolia	0.731
Tianjin	0.803	Jilin	0.885	Guangxi	0.882
Hebei	0.863	Heilongjiang	0.813	Chongqing	1.000
Liaoning	0.902	Anhui	0.938	Sichuan	0.913
Shanghai	0.981	Jiangxi	1.000	Guizhou	0.931
Jiangsu	0.965	Henan	0.997	Yunnan	0.830
Zhejiang	0.879	Hubei	0.998	Xizang	0.514
Fujian	0.798	Hunan	0.997	Shanxi	0.961
Shandong	0.963			Gansu	0.712
Guangdong	0.858			Ningxia	0.749
				Xinjiang	0.818

Source: formed by the author

3) Dynamic analysis of GFHE performance in China. With the help of DEAP 2.1 software, the study makes a dynamic analysis of the performance of GFHE on the Input-output Performance of higher education in 29 provinces and three areas in China, to calculate the changing trend of China's GFHE performance from the perspective of area and time. The relevant results are shown in Table 2.3. From a regional perspective, China's GFHE performance (comprehensive efficiency) level is the highest in central China, followed by eastern China, which is not much different from the national average level, and the lowest in western China. From the perspective of time, from 2008 to 2020, the overall level of China's GFHE performance was in the range of more than 0.85, which shows that China's higher education funding has high utilization efficiency and substantial input-output solid benefits.

There are significant differences in the scale of GFHE in eastern, central, and western China, with the highest in the east of, the second in the mid, and the least in the west of China. Therefore, it further reflects the imbalance of GFHE performance in the three areas.

Table 2.2 – Types of government funding performance in Higher Education in China

Type	Class I “inefficient” areas	Class II “medium efficiency” area	Class III “high efficiency” areas
Province	Fujian, Tianjin, Heilongjiang, Inner Mongolia, Yunnan, Gansu, Tibet, Ningxia and Xinjiang	Beijing, Hebei, Liaoning, Guangdong, Zhejiang, Shanxi, Jilin, Anhui, Sichuan, Guangxi and Guizhou	Shanghai, Jiangsu, Shandong, Jiangxi, Henan, Hunan, Hubei, Chongqing, Shaanxi

Source: formed by the author

The study further decomposes the comprehensive efficiency of China's GFHE performance into pure technical efficiency and scale efficiency (see figure 2.2). The complete efficiency has been fluctuating and rising from 2008 to 2020. The complete efficiency increased sharply after falling to the lowest point of 0.845 in 2011, reaching the maximum point in 2015, and finally reaching the peak of 0.964 in 2019.

Table 2.3 – Performance of Chinese GFHE from 2008 to 2020 (comprehensive efficiency)

Years	Areas			
	eastern China	central China	western China	whole country
2008	0.836	0.970	0.811	0.872
2009	0.837	0.988	0.813	0.879
2010	0.826	0.946	0.806	0.859
2011	0.825	0.923	0.787	0.845
2012	0.872	0.928	0.779	0.860
2013	0.832	0.959	0.816	0.869
2014	0.894	0.943	0.835	0.891
2015	0.914	0.933	0.881	0.909
2016	0.920	0.936	0.824	0.909
2017	0.912	0.948	0.852	0.904
2018	0.917	0.997	0.906	0.940
2019	0.973	1.000	0.918	0.964
2020	0.947	0.970	0.913	0.943
Average	0.885	0.957	0.842	0.894

Source: formed by the author

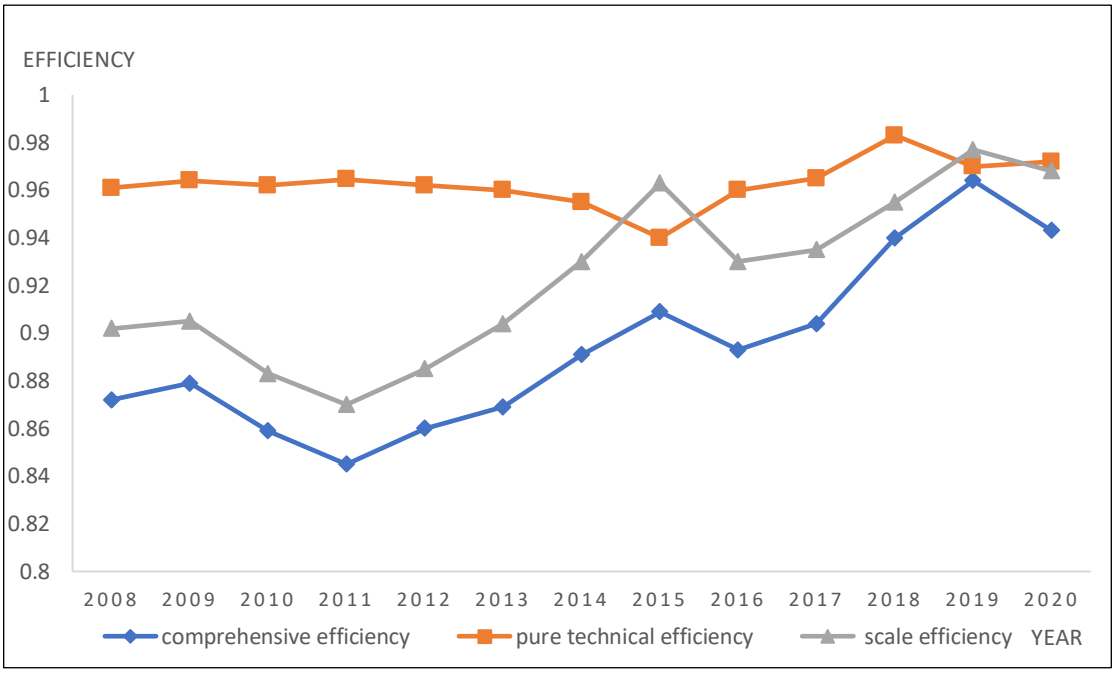

Figure 2.2 – Change trend of government funding efficiency (funding efficiency refers to DMU efficiency, which is between 0-1) in higher education in China

Source: formed by the author

4) Static analysis of GFHE performance in China. This paper selects the relevant indicators of 29 provinces in China in 2020 as the research sample, further decomposes their GFHE comprehensive efficiency into pure technical efficiency (PTE) and scale efficiency (SE) through the DEA model, and analyzes the return to scale. In 2020, the average PET value of GFHE in China's provinces was 0.973, namely non-technical and compelling, which means that GFHE has the problems of insufficient management level, inefficient use, and low input-output conversion rate. There are 19 provinces with PTE value of 1, which are distributed in eastern, central and, western areas. In comparison there are 16 provinces with an SE value of 1, which are mainly concentrated in east and central areas.

Empirical model setting and variable description. It can be seen from the above that there are many differences in GFHE regional performance. According to the impact of different economic and social factors on regional GFHE performance and combined with the existing literature, this paper uses the panel Tobit regression model for empirical analysis. Based on the panel data of 29 provinces in China from 2008 to 2020, this study

makes a quantitative analysis. The specific indicators selected as explanatory variables and their meanings are as follows:

- First, the per capita GDP (lnrgdp) reflects the degree of regional development;
- Second, the proportion of employees with a college education or above (PEC), which shows the level of the local labor force;
- Third, the degree of urbanization (UL), which reflects the degree of regional economic development;
- Fourth, the student-teacher ratio (TSD) of higher education institutions reflects the level of Regional Teacher Allocation;
- Fifth, the proportion of government financial expenditure in regional GDP (FE), which represents government financial resources. China's public higher education institutions mainly rely on government financial funding, so government financial resources have a specific impact on GFHE;
- Sixth, the proportion of tertiary industry output value in GDP (ind) of each province reflects the regional industrial development level.

Based on the panel Tobit regression model, the influence factors of GFHE performance in the country and the three areas are shown in Table 2.4.

The following is a one-by-one analysis of the influencing factors of GFHE performance in different areas. The whole country. Among the influencing factors of national GFHE regional performance, per capita GDP (coefficient = 0.1807, $P < 0.01$), the proportion of employees with college education or above (coefficient = 1.3711, $P < 0.01$) and the degree of urbanization (coefficient = 0.6913, $P < 0.01$) are the favorable factors; The ratio of students to teachers in higher education institutions (coefficient = -0.04661, $P < 0.05$) and the proportion of government expenditure in regional GDP (coefficient = -0.84091, $P < 0.05$) were the adverse factors; The proportion of tertiary industry output value in GDP in each province has no significant impact on it.

Eastern China. In eastern China, the per capita GDP (coefficient = 0.4942, $P < 0.1$) and the degree of urbanization (coefficient = 0.4721, $P < 0.05$) are the favorable factors affecting the performance of GFHE, while the student-teacher ratio of higher education

institutions (coefficient = -0.0738, P < 0.1) is the unfavorable factor. The proportion of employees with a college education or above, the proportion of government financial expenditure in regional GDP. The proportion of tertiary industry output value in GDP in each province has no significant impact on it.

Table 2.4 – The influence factors of GFHE performance in the whole country and the eastern, central, and western areas

Model	I (whole Country)		II (eastern China)		III (central China)		IV (western China)	
variable	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error	Coefficient	Std. Error
lnrgdp	0.1807***	0.0898	0.4942*	0.3293	-0.3399	0.3165	-0.0024	0.0059
pec	1.3711***	1.0715	-1.0971	1.0506	1.1182	1.5614	-0.1185**	1.2546
ul	0.6913***	0.5911	0.4721**	0.3001	0.2551**	0.3202	0.0074	1.4318
tsd	-0.04661**	0.0255	-0.0738*	0.0443	-0.3346*	0.4158	0.7261	0.5859
fe	-0.84091**	0.2780	0.0229	2.7481	2.5678	1.7431	-0.3017*	0.1634
ind	-0.5652	0.5664	0.0988	0,277	-0.3762***	0.1383	-0.1590*	0.0931

Note: *** is P <0.01, ** is P <0.05, * is P <0.1.

Source: formed by the author

The following is a one-by-one analysis of the influencing factors of GFHE performance in different areas. The whole country. Among the influencing factors of national GFHE regional performance, per capita GDP (coefficient = 0.1807, P < 0.01), the proportion of employees with college education or above (coefficient = 1.3711, P < 0.01) and the degree of urbanization (coefficient = 0.6913, P < 0.01) are the favorable factors; The ratio of students to teachers in higher education institutions (coefficient = -0.04661, P < 0.05) and the proportion of government expenditure in regional GDP (coefficient = -0.84091, P < 0.05) were the adverse factors; The proportion of tertiary industry output value in GDP in each province has no significant impact on it.

Eastern China. In eastern China, the per capita GDP (coefficient = 0.4942, P < 0.1) and the degree of urbanization (coefficient = 0.4721, P < 0.05) are the favorable factors affecting the performance of GFHE, while the student-teacher ratio of higher education institutions (coefficient = -0.0738, P < 0.1) is the unfavorable factor. The proportion of employees with a college education or above, the proportion of government financial expenditure in regional GDP. The proportion of tertiary industry output value in GDP in

each province has no significant impact on it.

Central China. In central China, the degree of urbanization (coefficient = 0.2551, $P < 0.05$) is the favorable factor affecting the performance of GFHE, while the ratio of students to teachers in higher education institutions (coefficient = -0.3346, $P < 0.1$) and the proportion of tertiary industry output value in GDP of each province (coefficient = -0.3762, $P < 0.01$) are the unfavorable factors The ratio of employees with a college education or above and the proportion of government expenditure in regional GDP have no significant impact.

Western China. In western China, the proportion of employed persons with a college education or above (coefficient = -0.1185, $P < 0.05$), the balance of government expenditure in regional GDP (coefficient = -0.3017, $P < 0.1$), and the ratio of tertiary industry output value in GDP of each province (coefficient = -0.1590, $P < 0.1$) are the unfavorable factors, and the per capita GDP The degree of urbanization and the ratio of students to teachers in higher education institutions have no significant impact on it.

This study creatively analyzes the relationship between the scale of GFHE and the level of funding performance in China for the first time. This is consistent with the theoretical hypothesis H1. Therefore, the theoretical hypothesis H1 is accepted. The analysis results show that the comprehensive efficiency has fluctuated and rose from 2008 to 2020. The total efficiency rose sharply after falling to the lowest point of 0.845 in 2011, reached the maximum point in 2015, and finally reached the peak of 0.964 in 2019, indicating that the comprehensive efficiency of China's GFHE performance is in the trend of overall fluctuation and rising, but presents the characteristics of «W-shaped» fluctuation and rising. This reflects that in the development process of China's GFHE system, with the continuous increase of funding, the corresponding management system is also constantly improved to keep up with the rise in funding, which promotes the improvement of funding performance level to a certain extent. Still this improvement of performance level is unstable. Such results suggest that with the continuous expansion of the scale of GFHE, the government and colleges and universities should strengthen cooperation and actively improve the use efficiency and management level of funds, to reduce the «W-shaped» fluctuation and improve the comprehensive efficiency of GFHE

performance.

There are significant differences in GFHE performance among the three areas in China, which is consistent with the theoretical hypothesis H2. Therefore, the theoretical hypothesis H2 is accepted. The performance level of government funding in the eastern area is in a stable upward stage from 2011 to 2019, the same as that of China in 2020. The funding performance level of the central area has always maintained the highest state from 2008 to 2019, and reached the highest point of comprehensive efficiency of 1.000 in 2019. As for the western area, the performance of government funding has always fluctuated at a low-efficiency level in all statistical years. The lowest point of 0.779 comprehensive efficiencies in the western area appeared in 2012 and the highest point of 0.918 appeared in 2019. There is a particular gap between the west and the national level, and the gap between the western and the eastern area is the largest. The results of this study are similar to those of Wang Shanmai (2013). The latter study shows that the differences in the allocation of educational resources among provinces in China are expanding, and the level of funding performance is also different. Moreover, the study also takes typical provinces in central, eastern, and western China as examples for empirical analysis. But it only analyzes distinct provinces lacks comprehensive research, and is not representative. This study makes up for the defects in this regard, and makes a macro analysis from a regional perspective, and the results are more objective.

The results of this study also show an imbalance in the development of GFHE performance among different provinces in the same area of China, which is consistent with the theoretical hypothesis H3. Therefore, the theoretical hypothesis H3 is accepted. Further analysis also shows that only 30% of the provinces have achieved efficient development in GFHE resource allocation and utilization. The rest of the provinces are still in the stage of low-efficiency operation. This is consistent with the research results of Wu Jiameng (2016) and Qin Zhifei (2014). But these two studies only analyze the uneven performance of GFHE in different provinces in an area as a whole They do not divide and analyze other provinces according to the performance level. This paper makes a detailed analysis of this aspect. From a regional perspective, China's GFHE performance presents the basic characteristics of the first in the central area, the second

in the eastern area, and the third in the western area. There are significant differences in the scale of GFHE funds in China, first in the east of, second in the central, and third in the area of west. The results of regional scale and performance are inconsistent. Class III "high efficiency" is mainly concentrated in eastern and central China. Shanghai, Jiangsu, and Shandong are typical eastern educationally powerful provinces and economically strong provinces, and their GFHE performance level is consistent with their strength. The high efficiency of GFHE performance in Jiangxi, Henan, Hunan, and Hubei provinces has a great relationship with implementing the central rise strategy. The guidance of national policies and the grasp of opportunities urge them to pay more attention to the funding in higher education and commit themselves to the efficient development of higher education quality, to cultivate more excellent talents to meet the needs of the rapid growth of the regional social economy. With the "Belt and Road" policy, Shanxi and Chongqing have gained considerable growth in higher education, and the quality level has been rapidly improved. Class II "medium efficiency" provinces and three areas have both. It is noteworthy that Beijing, as the center of China's politics, economy and culture, also belongs to class II "medium efficiency," which indicates that Beijing is insufficient in the allocation and utilization of GFHE resources, showing problems such as excessive input of resources and low input-output efficiency. Moreover, as economically strong provinces, Zhejiang Province and Guangdong Province also offer a low level of GFHE performance. The reason for its low efficiency is that the expansion speed of the GFHE fund scale does not keep a good fit with the improvement of quality. Class I "low efficiency" is mainly concentrated in the western area. The main reasons for its low efficiency are an underdeveloped economy, common scale of GFHE, and imperfect development of the higher education system.

The average PTE value of GFHE in China's provinces is 0.973, which is non-technical and compelling, indicating that GFHE has the problems of insufficient management level, inefficient use, and low input-output conversion rate. The average SE value of GFHE is 0.969, which is non-scale effective and lower than PTE, indicating that GFHE has a series of problems such as too serious or too low input or output, unreasonable funding allocation and, so on. There are 19 provinces with a PTE value of

1, distributed in the eastern, central, and western areas. In comparison there are 16 provinces with an SE value of 1, which are mainly concentrated in the central and east areas. The value of PTE is 1, which indicates that the province can make full use of GFHE funds. In contrast the provinces with suboptimal PTE need to improve PTE by improving GFHE management level, promoting resource allocation, and effective utilization, and improving input-output transformation mechanism. The value of SE is 1, which indicates that the GFHE of this province has reached the optimal scale. At the same time, the provinces whose SE has not reached the optimal scale have the problems of mismatch and too much or too little funding in the configuration and development needs of GFHE.

Theoretical hypothesis H4 suggests that China's GFHE performance may be affected by total population size, engel coefficient, per capita GDP, urbanization process, and the proportion of tertiary industry output value. However, this study shows that the performance of GFHE in the eastern area is mainly affected by the degree of regional development, the degree of urbanization, and the level of teacher allocation; The performance of GFHE in central China is mainly affected primarily by the degree of urbanization, the level of teacher Allocation and the level of regional industrial development. The performance of GFHE in the western area is mainly affected by the labor level, government financial resources, and regional industrial development level. The above results are not wholly consistent with the theoretical hypothesis H4. Therefore, the theoretical hypothesis H4 is rejected. Due to the most developed economy and paying enough attention to the development of the higher education industry, the eastern area has rich educational resources and a high standard of teachers. However, the proportion of teachers to students is too high, resulting in surplus teacher resources, which affects the social benefits of GFHE. In the central area, the teacher allocation level and regional industrial development level in the central area hurt GFHE performance. The degree of urbanization and the scale of higher education will have a positive impact on the performance of GFHE. The performance of GFHE in the western area is mainly affected by the labor level, government financial resources, and regional industrial development level. The story of economic development in the area of west is relatively low. The

industrial development mainly exists in the primary industry and the secondary sector. The growth of the tertiary sector lags obviously, which cannot effectively drive the local employment level, and the number of people with higher education is seriously lost. Mao Jianqing (2009), Wang Jianhong and Liu Yirong (2015), Zhang Yunxia and Wang shoulan (2014), Zhang Shuhui and He Juanjuan (2015) all explored the influencing factors of higher education development and university scale, and did not examines the influencing factors of GFHE performance. This paper not only analyzes the influencing factors of GFHE performance in different areas, but also further distinguishes between positive and negative element.

2.2. Modeling the success of the development of higher education institutions

Since the 1990s, the Chinese government has attached great importance to the construction of key disciplines in higher education institutions, invested a lot of construction funds, and local governments have given corresponding supporting support. higher education institutions have also fully realized the importance of discipline construction, and their investment in discipline construction has reached an unprecedented level. Under the circumstances that the state, local governments and higher education institutions strengthen discipline construction. It has become an important topic in the current research of higher education that how to evaluate the performance of discipline construction through scientific methods and combine the performance of discipline construction with discipline construction management supervision and decision-making guidance.

In the construction of the evaluation index system of input and output of discipline construction, we should reflect the contents of input and output. In terms of discipline construction investment, it can be summarized into three investment elements: fixed assets, human resources and capital investment. Among them, fixed assets refer to the material conditions such as experimental instruments and equipment, books and materials, laboratory area and classroom area invested in the discipline construction cycle. Human resources refer to the investment of teachers in the discipline construction

cycle, including the number of senior professional titles, deputy senior professional titles, intermediate professional titles and primary professional titles. Capital investment refers to the capital investment in the discipline construction cycle, including national special investment, local government investment, University self raised fund investment, social donation, etc. In terms of discipline construction output, according to the functions of colleges and universities, it can be summarized into two output elements: scientific research and talent training. Among them, scientific research includes scientific research projects, scientific research funds, scientific research achievements and scientific research bases. Talent training includes two aspects: one is the scale of talent training, including the scale of undergraduate, master and doctoral students; The second is the quality of talent training, including teaching achievement awards, national and provincial excellent papers, excellent courses and excellent teaching materials.

There are many methods of performance evaluation. From the current situation of performance evaluation research, it mainly includes two categories: index weight weighting method and data envelopment analysis (DEA) briefly. Among them, the index weight weighting method includes subjective weighting method and objective weighting method. It gives certain weight value to indicators at all levels through qualitative or quantitative research methods. It is a common method to solve performance evaluation at present. Data envelopment analysis is a quantitative research method. Its prototype is a fractional programming. By using transformation, the original problem can be transformed into an equivalent linear programming problem, and then a dual programming model can be obtained by using the dual theory of linear scale. It can solve the performance evaluation problem of multiple inputs and outputs without knowing or giving the weight value of each input element and output element in advance. It is a good means and method to solve the performance evaluation of multiple inputs and outputs. Index weight method and data envelopment analysis method have their own advantages and disadvantages. The advantage of index weight weighting method is that it is easy to operate, and can be combined qualitatively and quantitatively.

In the performance evaluation of multiple inputs and outputs, it is convenient to further analyze the contribution of various inputs to outputs. Its disadvantage is that it is

greatly affected by subjective factors and the scientificity of the conclusion is affected. Data envelopment analysis has great advantages, that is, it has greater inclusiveness to input and output indicators, can accept those indicators that are difficult to quantify in a general sense, and has more advantages than general conventional statistical methods in dealing with evaluation problems. The main performance is as follows:

1. Firstly, multiple input and output indicators can be calculated at the same time. The input and output data can be indicators of different measurement units, and there is no need to determine the relationship and weighting value between indicators in advance.

2. Secondly, DEA method has changed the situation of confusing effective and non-effective in the past evaluation methods, and estimated the really effective production frontier.

3. Thirdly, it is committed to the optimization of each evaluation unit rather than the statistical regression optimization of the whole set. Compared with the traditional econometric methods, DEA does not need to know the function form with parameters in advance.

Discipline construction performance evaluation involves a variety of inputs and outputs. Input elements and output elements also contain multi-level indicators such as primary indicators, secondary indicators and tertiary indicators, and are different types of data. It is difficult to evaluate its construction performance scientifically by weighting method. Data envelopment analysis can solve this problem well. At present, scholars have applied this method to the performance evaluation of discipline construction, which is an active exploration of applying modern management methods to the practice of higher education.

However, there are some problems in the application of this method. This method only solves the problem of whether different discipline construction objects are effective in result performance, and lacks the examination of discipline construction process performance. Therefore, the author believes that in order to realize the scientific examination of discipline construction performance evaluation, we should not only solve the performance problems in the results of discipline construction, but also solve the performance problems in the process of discipline construction. It is necessary to

combine the envelope analysis method with the weight weighting method for comprehensive evaluation, which is a more reasonable method to solve the performance evaluation of discipline construction. Specifically, the data envelopment analysis method is used to solve the problem of result performance evaluation of different discipline construction objects. At the same time, the weighting method, especially the objective weighting method, is used to solve the problem of human, financial and material input performance in discipline construction, and scientifically evaluate and examine the process of discipline construction, so as to realize the evaluation of comprehensive examination of discipline construction input and output, Realize the comprehensive evaluation of the process and results of discipline construction performance evaluation.

The input and output indicators of the above disciplines are dimensionless, and the dimensionless treatment formula is:

$$ki=\frac{x_i - \min x_i}{\max x_i - \min x_i} \text{ , } i=1,2,3, \ldots\ldots \text{ , } n \qquad (2.4)$$

Where, ki represents the standardized value of index xi, kiI[0,1]; Min xi represents the minimum value of index xi in the overall evaluation object; Max xi represents the maximum value of index xi in the whole evaluation object.

The basic idea of indicator weighting is to determine the objective weight of indicators, which is based on two basic concepts. One is contrast strength. It represents the value difference between each evaluation scheme of the same index in the form of standard deviation. That is, the size of the standardized difference indicates the size of the value difference between schemes within the same index. The larger the standard difference, the larger the value difference between schemes. The second is the conflict between evaluation indicators. The conflict between indicators is based on the correlation between indicators. If there is a strong positive correlation between the two indicators, it shows that the conflict between the two indicators is low. The quantitative

indicator of the conflict between the j-th indicator and other indicators is $\sum_{t=1}^{n}$ （1-rtj）, rtj is the correlation coefficient between the evaluation indexes t and j, and the objective weight of each index is determined by the comprehensive measurement of contrast intensity and conflict. Let Cj represent the amount of information contained in the j-th evaluation index, then Cj can be expressed as:

$$Cj = sj \sum_{t=1}^{n} （1\text{-}rtj）， j=1,2,3，…，n \tag{2.5}$$

The greater Cj, the greater the amount of information contained in the j-th evaluation index, and the greater the relative importance of the index, so the objective weight of the j-th indicator should be:

$$Wj = \frac{C_j}{\sum_{j=1}^{n} Cj}， j=1，1,2,3，…，n \tag{2.6}$$

Data envelopment analysis is a new cross research field of operations research, management science and mathematical economics. It is a quantitative analysis method to evaluate the relative effectiveness of comparable units of the same type by using the method of linear programming according to multiple input indicators and multiple output indicators. Since the DEA method and its model were proposed by A. Charnes and W. W. Cooper in 1978, it has been widely used in different industries and departments, and has shown its unique advantages in dealing with multi-index input and multi-index output.

At present, a technology has been developed, which can be used to compare the efficiency of multiple service units providing similar services by explicitly considering the use of multiple inputs (i.e. resources) and the generation of multiple outputs (i.e. services). This technology is called data envelopment analysis (DEA). It avoids calculating the standard cost of each service, because it can convert a variety of inputs and outputs into the numerator and denominator of efficiency ratio without converting

into the same monetary unit. Therefore, using DEA to measure efficiency can clearly explain the combination of input and output, so it is more comprehensive and reliable than a set of operating ratio or profit indicators. DEA is a linear programming model, expressed as the ratio of output to input. By comparing the efficiency of a specific unit with the performance of a group of similar units providing the same service, it attempts to maximize the efficiency of service units. In this process, some units that obtain 100% efficiency are called relative efficiency units, while others with an efficiency score lower than 100% are called invalid rate units. In this way, enterprise managers can use DEA to compare a group of service units, identify relative inefficiency units, measure the severity of inefficiency, and find ways to reduce inefficiency through the comparison of inefficiency and efficiency units.

The DEA linear programming model is established as follows:

1) define variables. Let EK (k = 1, 2,..., K) be the efficiency ratio of the kth unit, where k represents the total number of evaluation units. Let UJ (J = 1, 2,..., m) be the coefficient of the j-th output, where M represents the total number of output types considered. Variable UJ is used to measure the relative efficiency decline caused by the reduction of output value by one unit. Let VI (I = 1, 2,..., n) be the coefficient of the i-th input, where n represents the comprehensive prime of the considered input type. The variable VI is used to measure the relative efficiency decline caused by the reduction of input value by one unit. Let ojk be the number of observed units of the j-th output created by the k-th service unit in a certain period. Let iik be the actual number of units of the i-th input used by the k-th service unit in a certain period.

2) The objective function is to find a set of coefficients u accompanying each output and a set of coefficients accompanying each inputv ، So as to give the highest possible efficiency to the evaluated service unit. (*) where e is the code of the evaluated unit. This function satisfies the constraint that when the coefficients (UJ and VI) of the same set of inputs and outputs are used for all other comparative service units, no service unit will exceed 100% efficiency or 1.0 ratio.

3) Constraints k=1,2,……,K

Where all coefficient values are positive and non-zero.

In order to solve this fractional linear programming with standard linear programming software, deformation is needed. Note that the objective function and all constraints are ratios rather than linear functions. By artificially adjusting the input of the evaluated unit to the sum of 1.0, the objective function of equation (*) can be re expressed as:

The following constraints are met:

For multiple service units, the constraints of equation can be similarly transformed into:

k=1,2,…,K

Where UJ ≥ 0, j = 1, 2,..., m VI ≥ 0, I = 1, 2,..., n

The common DEA planning model is analyzed and solved by lingo.

The sample size of service units is determined by comparing the number of selected input and output variables in the analysis species. The following relationship connects the number of service units K and the number of input types n considered in the analysis with the number of output types m. It is based on empirical findings and DEA practice experience: data envelopment analysis includes cost indicators and benefit indicators.

Analysis of matrix model. The secondary indicators of input and output are weighted according to the index weighting method, and the input and output are linearly weighted and summed respectively. The linear summation formula of the comprehensive value of input and output is as follows:

Comprehensive input value= $\sum_{i=1}^{n} wixi$ ，i=1,2，…，n

Comprehensive output value= $\sum_{i=1}^{n} wiyi$ ，i=1,2，…，n

Data collection and data processing. In the examination of the process and results of discipline construction performance evaluation, we should mainly consider the following two points: first, in the examination of discipline construction investment, we should consider the changes of discipline construction investment in the time dimension,

that is, according to the changes of time, whether the absolute value of discipline construction in fixed assets, human resources and capital investment shows an upward trend or a downward trend. In terms of the development momentum of fixed assets, human resources and capital investment, is the growth value of discipline construction increasing or decreasing. Second, in the selection of primary, secondary or tertiary index values in the discipline construction input and output index system, we should consider the sustainability, long-term nature and delayed effectiveness of discipline construction. For the discipline construction input and output index values, we should not select the relevant data of a certain year, but the average value of input and output indexes in a certain construction cycle. In this way, in order to truly and scientifically reflect the input and output of discipline construction in a certain period, and to scientifically and reasonably evaluate the discipline construction performance of a discipline construction object. The following takes each college of a university in China as the object, and uses the above methods to make an empirical analysis on the discipline construction performance.

The university has 20 discipline groups. The input of each discipline group is shown in Table 1, and the output of each college is shown in Table 2.5 and A.1-A5 in appendix A.

Calculation of comprehensive value of input-output indicators of discipline construction. After the dimensionless processing results of various indicators of discipline construction input and output are weighted and integrated with their weight values, the comprehensive values of discipline construction input and output indicators are shown in Table 2.6, and the comprehensive values of discipline construction output indicators are shown in Table 2.6.

The data envelopment analysis method is used to analyze the comprehensive index values of input and output of discipline construction. C2R model is used to process the input and output of discipline construction of the University, and the results are shown in appendix B.

Table 2.5 – Discipline construction investment of each college

Name of discipline group	Input index								
	fixed assets		human resources				Capital investment		
	Area of teaching and scientific research site (m2)	Instruments and equipment	Number of people with senior professional titles	Number of people with vice senior titles	Number of people with intermediate professional titles	Number of junior professional titles	National special fund (RMB 10000)	Local special funds (RMB 10000)	Self raised funds of the school (RMB10000)
G1	6155	1977.67	13	53	33	1	295	0	171
G2	5183	1663.76	3	28	13	3	60	0	0
G3	1694	412.27	14	52	52	5	92	20	95
G4	11359	4396.25	49	106	112	5	624	0	486
G5	1936	791.4	13	25	36	1	124	15	170
G6	4571	718.88	17	27	55	2	153	20	120
G7	1642	257.65	15	94	130	18	30	5	0
G8	8685	2123.27	15	34	32	4	500	0	294
G9	1038	217.46	10	34	18	1	62	15	80
G10	2517	619.89	13	12	17	1	115	0	0
G11	14176	4463.14	40	71	37	3	2286	65	1814
G12	12748	3183.12	32	42	45	4	1110	24	850
G13	4915	1164.7	34	75	41	6	180	15	130
G14	7367	2856.53	33	69	37	6	954	0	706
G15	9993	4625.51	14	27	29	4	656	0	679
G16	8038	1781.09	22	50	50	3	596	0	771
G17	8108	2278.16	11	26	21	2	574	0	836
G18	6129	2358.64	22	31	18	3	809	0	956
G19	5320	2519.4	14	45	34	6	410	0	674
G20	4810	1304	13	55	58	4	239	0	100

*note: the statistical time of human resources and fixed assets is December 31, 2020; The statistical time of financial data is from January 1, 2010 to December 31, 2020.

Source: formed by the author

The data envelopment analysis method is used to analyze the comprehensive index values of input and output of discipline construction. C2R model is used to process the input and output of discipline construction of the University, and the results are shown in appendix B.

Table 2.6 – Comprehensive value of input index

Input indicators	fixed assets	human resources	Capital investment
	X1	X2	X3
G1	0.3946	0.1944	0.0554
G2	0.3222	0.0589	0.0030
G3	0.0469	0.2911	0.1661
G4	08706	0.7726	0.1414
G5	0.1007	0.1466	0.1461
G6	0.1878	0.2300	0.1765
G7	0.0267	0.7135	0.0360
G8	0.5038	0.2144	0.0966
G9	0.0000	0.1083	0.1246
G10	0.1014	0.0874	0.0085
G11	0.9807	0.4909	1.0000
G12	0.7770	0.3896	0.4244
G13	0.2532	0.4928	0.1449
G14	0.5429	0.4620	0.2119
G15	0.8481	0.1873	0.1775
G16	0.4397	0.3165	0.1869
G17	0.5012	0.1196	0.1959
G18	0.4389	0.2261	0.2397
G19	0.4285	0.2589	0.1521
G20	0.2659	0.2875	0.0378

Source: formed by the author

Table 2.7 – Comprehensive values of output indicators

Output indicators	Talent training scale	research project	research project	research funds	Scientific research achievements	Scientific research base
	Y1	Y2	Y3	Y4	Y5	Y6
G1	0.325981	0.10548	0.046773	0.214776	0.023575	0
G2	0.073148	0.009714	0.041893	0.364228	0.017505	0
G3	0.113964	0.043665	0.009759	0.038529	0	0
G4	0.303765	0.541225	0.387077	0.215884	0.187422	0
G5	0.248474	0.084348	0.071169	0.064814	0.017505	0
G6	0.183373	0.228365	0.004879	0.10903	0	0
G7	0.048672	0.14314	0	0	0	0
G8	0.266655	0.142311	0.029555	0.245535	0.21382	0.145267
G9	0.016234	0.138229	0.004879	0.018549	0	0
G10	0.016533	0.03617	0.108462	0.086093	0.090384	0.072634
G11	0.921242	0.854333	1	1	1	1
G12	0.389409	0.247125	0.192249	0.678354	0.090187	0.145267
G13	0.828845	0.194824	0.381639	0.306706	0.145872	0.145267
G14	0.538948	0.310442	0.182211	0.440369	0.23047	0
G15	0.289187	0.213894	0.204587	0.38372	0.089951	0.072634
G16	0.437122	0.141211	0.18479	0.481381	0.079496	0.072634
G17	0.271333	0.098317	0.051372	0.295895	0.04347	0
G18	0.238643	0.205944	0.231004	0.385787	0.350859	0.072634
G19	0.562419	0.332237	0.12798	0.297576	0.066103	0.072643
G20	0.39755	0.067649	0.194828	0.20797	0.088737	0

Source: formed by the author

After preliminary analysis, it can be seen that 13 colleges such as G1, G11, G13, G17, G18, G19 and G20 have effective technology and scale, while 7 colleges such as G12 and G14 have effective non DEA scale. In order to further analyze the input-output performance of the above seven discipline groups, C2GS2 model is used for processing, and the processing results are shown in Table 2.8.

Table 2.8 – C2GS2 model result discrimination of non DEA effective DMU

Criterion	θ0	$\frac{1}{q^0}\sum_{j=1}^{n} l_j^0$	θ1	$\frac{1}{q1}\sum_{j=1}^{n} l_j^1$	Valid type
G3	0.6635	1.3029	0.7083	1.4119	ineffective technology and decreasing return on scale
G5	0.9936	0.3833	1	1	Effective technology and increasing returns to scale
G6	0.8447	1.3421	0.9266	1.0792	ineffective technology and decreasing return on scale
G12	0.7724	2.8542	1	1	Effective technology and decreasing returns to scale
G14	0.8936	2.7450	1	1	Effective technology and decreasing returns to scale
G15	0.9647	2.7450	0.9750	1.0256	ineffective technology and decreasing return on scale
G16	0.9445	1.1092	1	1	Effective technology and decreasing returns to scale

Source: formed by the author

Through analysis and processing, it can be seen that in terms of input and output performance, among the seven discipline groups, G5, G12, G14 and G16 are relatively good, while G15, G3 and G6 are relatively poor.

Analysis of matrix model. The secondary indicators of input and output are weighted according to the index weighting method, and the input and output are linearly weighted and summed respectively. The linear summation formula of the comprehensive value of input and output is as follows:

Comprehensive input value= $\sum_{i=1}^{n} wixi$ ，i=1,2，…，n

Comprehensive output value= $\sum_{i=1}^{n} wiyi$ ，i=1,2，…，n

According to this formula, the comprehensive total value of input and output of

each college of the university is obtained, as shown in Table 2.9.

Table 2.9 – Matrix average calculation

Matrix elements \ evaluation objects	input	output	Matrix region
	Horizontal axis	Longitudinal axis	
G1	20.1076	14.6129	V
G2	10.9505	7.7529	V
G3	19.8155	4.9349	V
G4	59.1032	40.0138	I
G5	12.5794	9.4982	V
G6	19.2004	16.5212	V
G7	40.0461	8.1918	IV
G8	24.3059	14.5751	V
G9	7.9143	7.4178	V
G10	5.0688	5.4453	V
G11	71.9035	89.8110	I
G12	46.2012	29.7790	II
G13	30.3753	31.7186	IV
G14	38.8268	34.4830	IV
G15	33.8275	22.2202	IV
G16	30.1843	22.4087	IV
G17	23.1384	14.7856	V
G18	26.3849	25.8318	IV
G19	27.2380	31.7395	IV
G20	21.9785	15.2856	V

Source: formed by the author

The average input value of all the above subject groups is 28.46 and the average output value is 22.35. The average value of 12 subject groups above the average value is calculated again, in which the average value of input is 43.81 and the average value of output is 38.22. According to these two sets of data, the input and output values of all discipline groups can be represented in the matrix, and the graph is shown in Figure 2.3.

As can be seen from Figure 2.3, there are two discipline groups in zone I, and the input and output of discipline construction are at the highest level in the University, and the discipline development is in the best state; There are 7 discipline groups in Zone IV, the input and output levels of discipline construction are high, and the discipline development is in a good state; There are 10 subject groups in Zone V, their input and

output are low, and the subject development is in a poor state; There is one discipline group in zone II, with high input and low output, and the discipline development status is the worst.

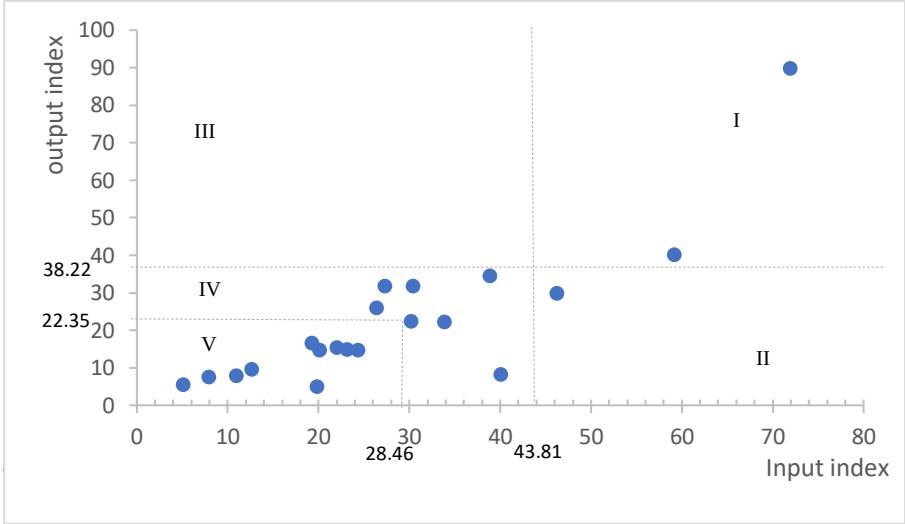

Figure 2.3 – Graphical display of research results

Source: formed by the author

From the above data envelopment analysis method and matrix analysis method, it can be seen that although the analysis results are different, they are generally consistent. Combining the two analysis methods, we can make an in-depth study on the discipline construction performance of each discipline group and draw a more scientific conclusion. G4 and G11 have high input and high output. After envelope analysis, they have achieved scale efficiency and technology efficiency. Therefore, the discipline construction performance of these two discipline groups is the best, and they are in the first echelon of the University. G7, G13, G18 and G19 have high input and output. After envelope analysis, they have also achieved scale effectiveness and technology effectiveness, and are in the second echelon of the University. The discipline construction of the seven discipline groups G20, G1, G2, G8, G9, G10 and G17 has low input and output. Through envelope analysis, it has also achieved effective scale and technology, and is in the third echelon of the University. G5 discipline construction has low investment and low output. It has achieved effective technology and not effective

scale, but the scale income is increasing, which is in the fourth echelon. G14, G15 and G16 disciplines have high input and output, fail to achieve effective scale, and the return on scale is decreasing, so they are in the fifth echelon. The input and output of G3 discipline construction are low, the scale is not effective, and the return on scale is decreasing, which is in the sixth echelon. G12 discipline construction has high input and low output, does not achieve effective scale, and the scale effect decreases, and is in the seventh echelon.

2.3. Marketing and promotion of knowledge services based on the micromedia model as a part of innovative processes in higher education institutions

As service organizations, libraries have been given a new mission and function in the era of the knowledge economy. The marketing promotion of library knowledge services has become a vital link to improve service quality. Library services are no longer limited to essential services such as borrowing and circulation of collection resources. Extended services such as reference, information retrieval and other information services, discipline services and knowledge services have increasingly become important content in library services. In the information age, it may be difficult for users to accurately and comprehensively find the information and knowledge they need without professional training and high information and knowledge literacy. At this time, the knowledge service of the library is particularly important.

The real-time interaction of micro media provides communication power for the promotion of library knowledge services. As a public service, the process of library knowledge service is the process of communication. The communication channel is interpersonal communication, and the motivation of communication is the acquisition, transmission and communication of information and knowledge. The library makes reasonable and appropriate use of microblog, WeChat and other micro medias to provide users with all kinds of knowledge in a timely manner, effectively collect users' opinions and understand their attitudes, which is conducive to the library providing users with knowledge services that are more suitable for their personality and needs, while

providing more targeted solutions.

Closely combined with the media platform with large market share and wide user base, this study applies marketing theory (4I principle of network marketing) to library knowledge service, studies the successful cases of 42 world-class universities ("double first-class") university library knowledge service marketing, and analyzes the application of micro media platforms in university library knowledge service marketing promotion. Through network research, this paper collects data, analyzes marketing knowledge, and uses dynamic model analysis to determine the influencing factors that limit the application of micro media in knowledge service marketing promotion. At the same time, it proposes a corresponding marketing strategy which aims to provide the basis for the library to formulate the marketing plan for knowledge service, which plays an important role in significantly promoting the development and upgrading of knowledge service and library knowledge service.

This dissertation proposes the following hypotheses:

H1: Microblogs and WeChat have been widely used in the marketing and promotion of knowledge services in university libraries because of their simple installation and low maintenance cost.

H2: The higher the popularity of a university more people pay attention to its library's micro media.

H3: The greater the number of articles pushed by micro media in university libraries the higher the update frequency, and the more people are concerned.

H4: University library microblogs and platform message feedback timeliness are positively correlated with the number of people who pay attention.

H5: The launch of microfilms by university libraries will help them building up a brand image and increasing the attention of users.

H6: In the market economy environment, university library staff generally have an awareness of marketing promotion and related knowledge.

H7: University libraries have generally opened the «knowledge service» column on their official websites, and most of them can refine and classify their services, provide personalized services, and have the ability to marketing and promotion knowledge

services through micro media to improve users' use viscosity and attention.

This study is to construct the dynamic model of micro media marketing of knowledge service in university library based on the 4I principle of network integrated marketing and the "pyramid" three-dimensional communication model.

This paper applies the 4I principle of network integrated marketing, which are:

1) The principle of interesting is to attract consumers in interesting ways or contents.

2) The principle of interests is indeed based on material interests. In addition, it also includes meeting consumers' information, psychological and other needs.

3) The principle of interaction is based on the interactivity of the network to attract consumers to participate in the process of product production or marketing, and their use experience can be fed back.

4) The principle of individual is to carry out personalized marketing according to the characteristics that different consumers have different characteristics.

The application of the 4I principle in libraries will have an important impact on knowledge services. The knowledge service taking the network as the main battlefield of marketing is affected by the 4I principle and presents new characteristics in the micro media environment, as shown in Figure 2.4.

The «pyramid» three-dimensional communication model was proposed by Yu Suo (2015). This model is different from the linear knowledge communication model. It considers that in the new media environment, knowledge communication is no longer a one-to-many communication from knowledge authority publisher to knowledge receiver, but a three-dimensional communication that everyone can participate in. At the same time, it also has the interactivity of feedback mode, and on the premise that time and space are no longer restrictive factors. This communication mode has become a symbol of openness. Moreover, the control in the process of knowledge dissemination is also contained in the whole media environment. Whether for the participants of knowledge dissemination or the media itself, the communication rules are contained in it. «Pyramid» three-dimensional communication mode, which shows that in the media environment not limited by time and space, the actors participating in knowledge communication are

communicators, the receivers are weakened in this communication mode, and the obvious boundaries of the traditional media era have been broken between knowledge participants.

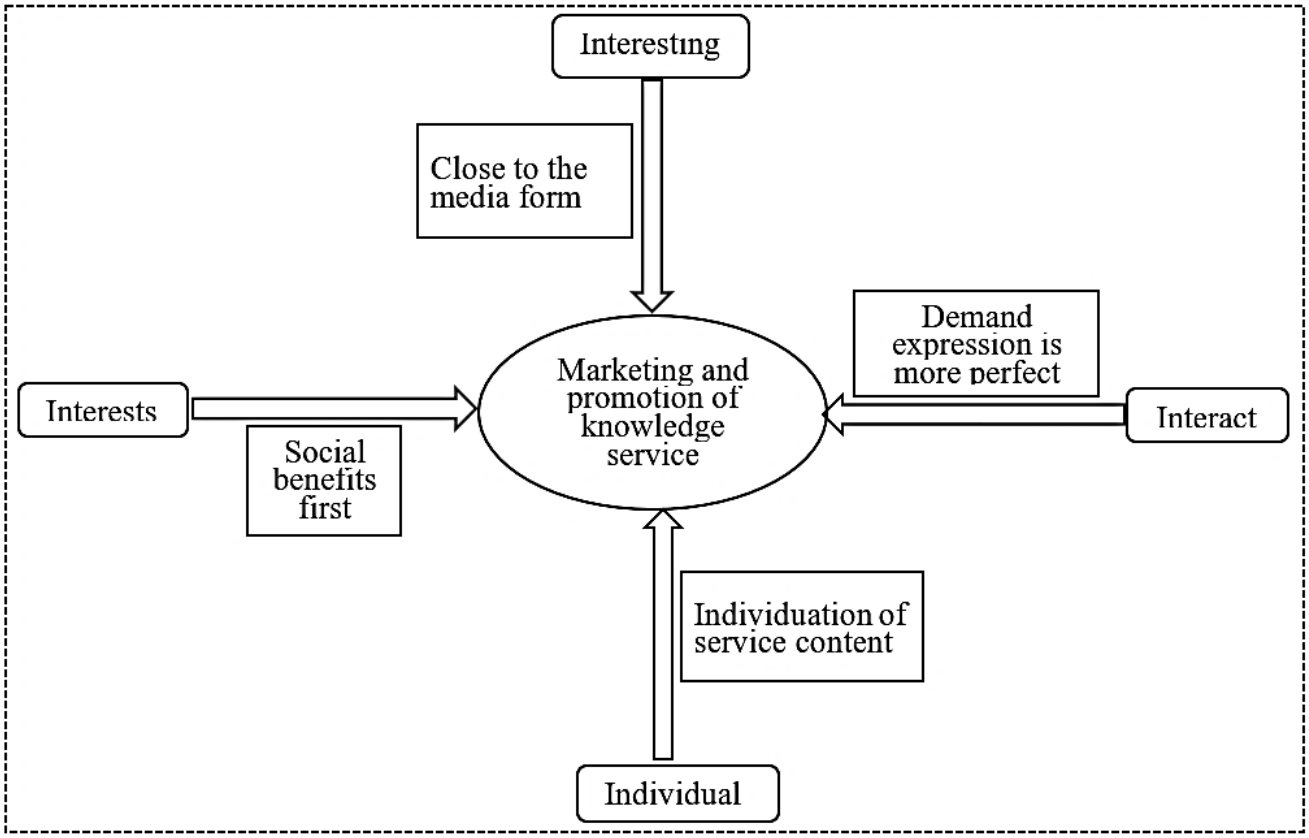

Figure 2.4 – The influence of 4I principle on the marketing of knowledge service in university library from the perspective of micro media (Don Schultz, In the 1990s)

Source: formed by Don Schultz

More importantly, what the "pyramid" three-dimensional communication model reveals is that it is completely possible to achieve equality among all new media users and jointly achieve the purpose of knowledge sharing (Figure 2.5).

Based on the perspective of micro media, this paper introduces the 4I principle of network marketing and the "pyramid" three-dimensional communication mode into the field of library, determines WeChat marketing, microblog marketing and microfilm marketing as the research objects of university library knowledge service marketing promotion mode from the perspective of micro media, and constructs the power model of university library knowledge service marketing promotion from the perspective of

micro media (Figure 2.6).

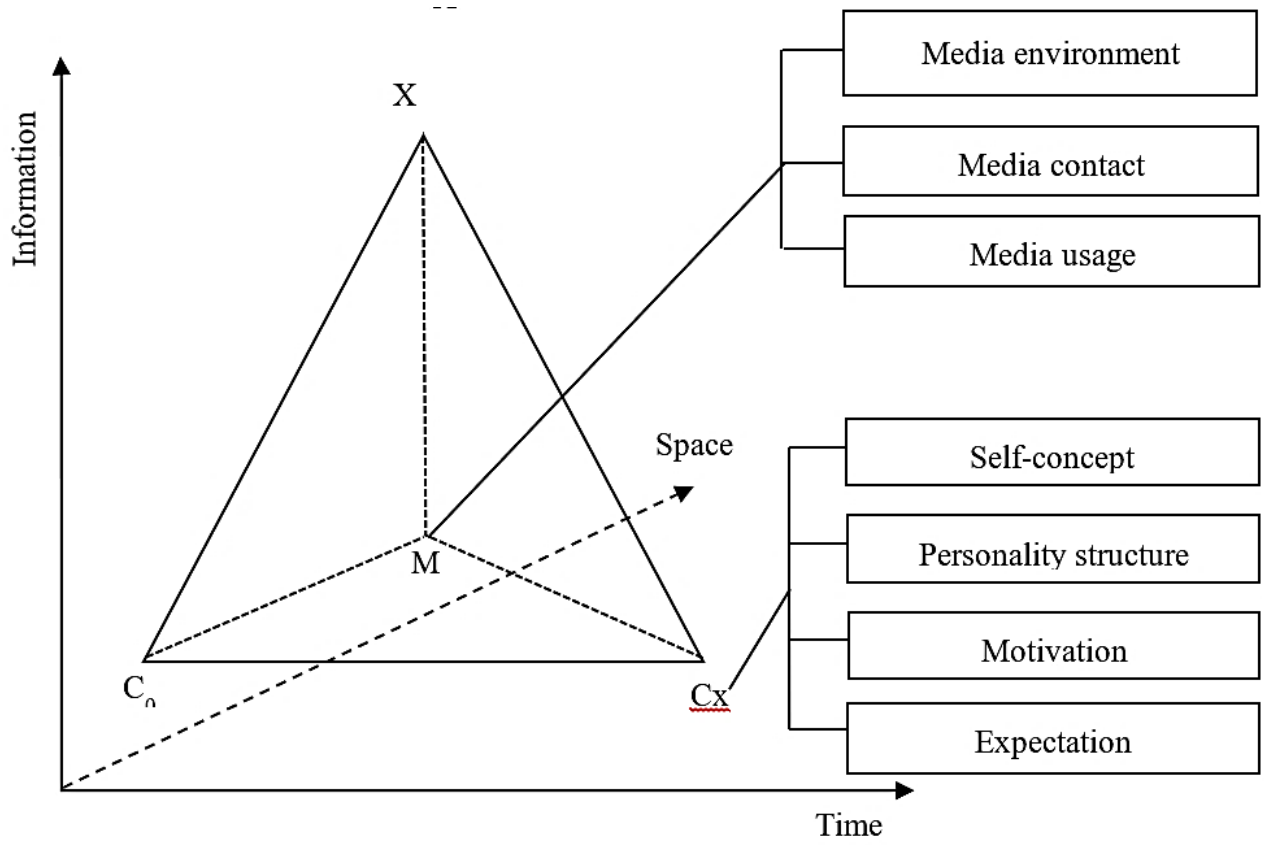

Figure 2.5 – Pyramid three-dimensional transmission mode (M for medium, C for knowledge participant and X for knowledge) (Suo Yu, 2015)

Source: formed by Suo Yu

According to the dynamic model, the success of micro-media marketing of knowledge service in university libraries depends on five dynamic elements: user experience, media technology, resource reserve, service content, and operation, and publicity. These five dynamic elements affect the induction and summary of the micro media marketing promotion strategy of knowledge service in a university library. Choosing comfort, communication, popularity, loyalty, and satisfaction as the evaluation factors of knowledge service marketing effect can guide the analysis of the current situation of "double first-class" micro media marketing promotion of knowledge service in the university libraries. When it comes to user experience, the first thing people think of is the user's satisfaction with knowledge service. Still, comfort covers the psychological evaluation and emotional tendency of users in the process of knowledge service in addition to pleasure.

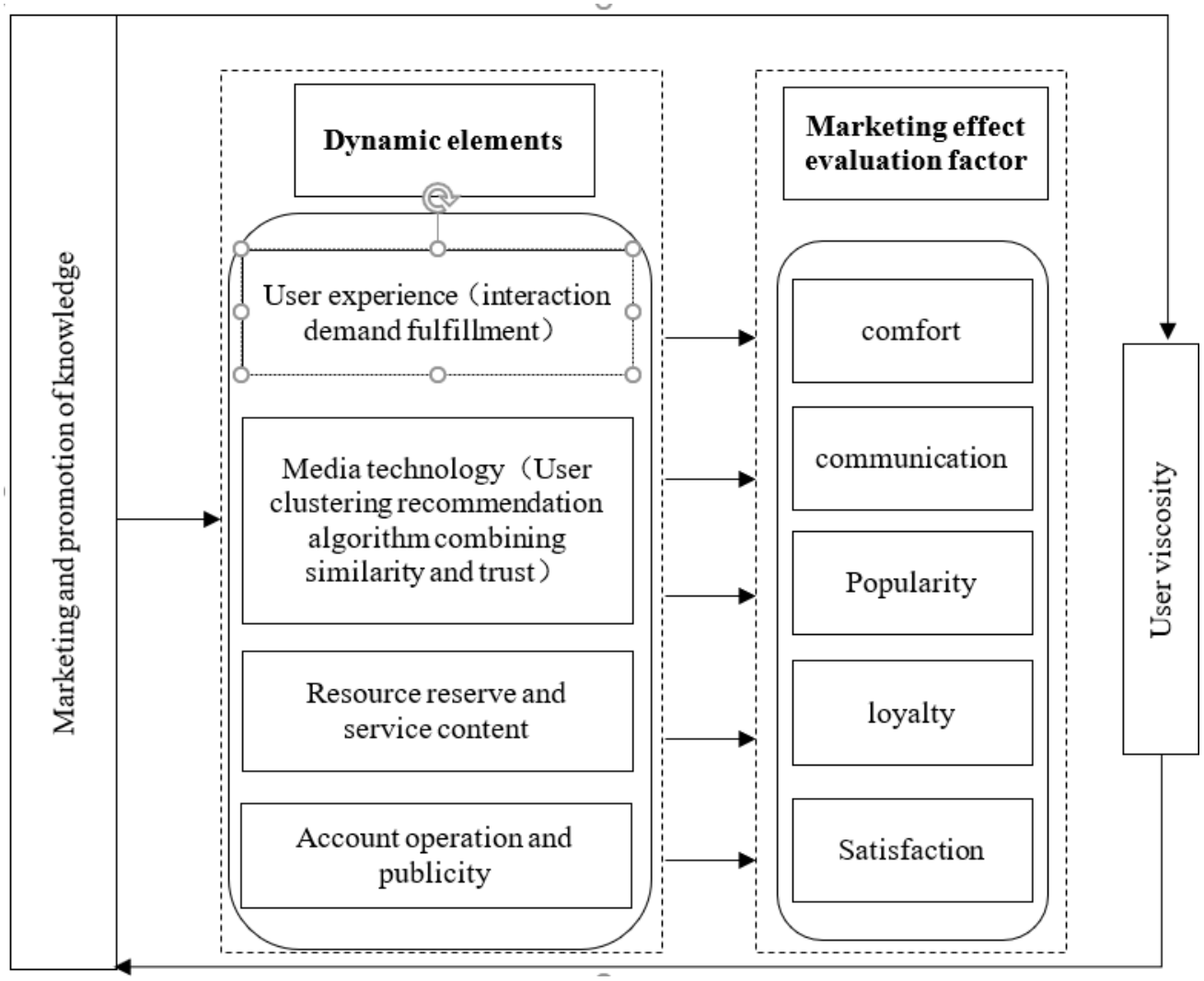

Figure 2.6 – The dynamic model of marketing promotion of knowledge service in university libraries from the perspective of micro media

Source: formed by the author

Therefore, comfort explains the connotation of user experience more comprehensively. Media technology determines the dissemination and popularity of knowledge service marketing. Resource reserve and service content affect users' loyalty to library knowledge services. Using micro media for knowledge service marketing involves whether users are satisfied with the operation and publicity. The dynamic marketing factor of the model determines the marketing effect evaluation factor, and the marketing effect evaluation factor determines the viscosity of users to the knowledge service of a university library. Only when the user viscosity is high and stable, the micro media marketing promotion of knowledge service in a university library is successful.

On the contrary, the success of promoting knowledge service marketing in university libraries will also enhance user viscosity. The two are a process of mutual influence and publicity.

Based on the dynamic model of knowledge service marketing promotion of university Library from the perspective of micro media, this paper selects the methods, objects and contents of this research.

"Double first-class" colleges and universities play an exemplary and leading role in optimizing the curriculum system and teaching content, discipline development and evaluation, talent training and innovation ability training, and promoting the reform of higher education teaching methods and means. The research object is determined as the 42 "double first-class" university library, which has certain forerunners and references.

This online survey includes four aspects: First is to search the user named "University Library" through Sina microblog, identify and follow the official microblogs of "Double First-class" university libraries, and then conduct a survey of the number of posts, the number of fans (i.e., attention) and the number of knowledge service posts on their official microblogs. Second, we searched the official public account and subscription account named "University Library" through WeChat, followed the WeChat public account corresponding to the list of "double First-class" universities, and investigated the frequency of sending articles and the frequency and content of knowledge service articles. Third, through website search, information push, literature research and official website research, determine whether "double first-class" universities have carried out marketing promotion of knowledge service through microfilm. Fourth, through browsing and studying the websites of 42 "double first-class" university libraries one by one, we determined whether there is a knowledge service column on the homepage of their websites (that is, whether to promote their knowledge service through the website). If yes, whether the location is eye-catching and what knowledge service content is advertised. In the process of this survey, any uncertain situations were solved through online interviews such as WeChat service number consultation and microblog consultation. All data in this paper are from January 1, 2020 to December 31, 2020, and the survey period is up to January 10, 2021.

Through in-depth research on the marketing and promotion of the knowledge service of a "double first-class" university library and statistical data, a questionnaire on the marketing and promotion of the knowledge service of a "double first-class" university library was obtained (appendix C.1).

Forty-two "double first-class" universities in China, in addition to seven university libraries have no microblog accounts. Three university libraries only have personal microblog accounts. The other 32 university libraries have Sina official verified microblog accounts. The "double first-class" university libraries account for 83.3% of microblog accounts, while the official microblog accounts of university libraries account for 76%. Tsinghua University Library, Wuhan University Library, Peking University Library, Xiamen University Library, Fudan University Library, Sichuan University Library and Chongqing University Library rank as the top seven among the "double first-class" university libraries in terms of microblog attention. It was followed by more than 18,000 people. The libraries of Harbin Institute of Technology, Beijing Normal University, Northeastern University, South China University of Technology, Central South University, Huazhong University of Science and Technology, and Tianjin University ranked in the bottom seven (Figure 2.7).

The top seven university libraries are Tongji University Library, Sichuan University Library, Tsinghua University Library, Wuhan University Library, Chongqing University Library, Peking University Library and Xiamen University Library, which all send more than 2,900 articles. The libraries in the bottom seven are the library of Beijing Institute of Technology, the library of Beijing Normal University, the library of Tianjin University, the library of Northwest A&F University, the library of Central South University, the library of University of Science and Technology of China and the library of Huazhong University of Science and Technology. Tongji University Library, Tsinghua University Library and Peking University Library ranked top three among the top seven university libraries in the amount of publishing knowledge services, respectively (Figure 5). In terms of the timeliness of microblog message consultation and feedback, among the 35 university libraries, 6 (17.1%), 12 (28.57%), 18 (51.43%) and 21 (60%) university libraries replied within 1 day, 3 days, 7 days and 30 days

respectively.

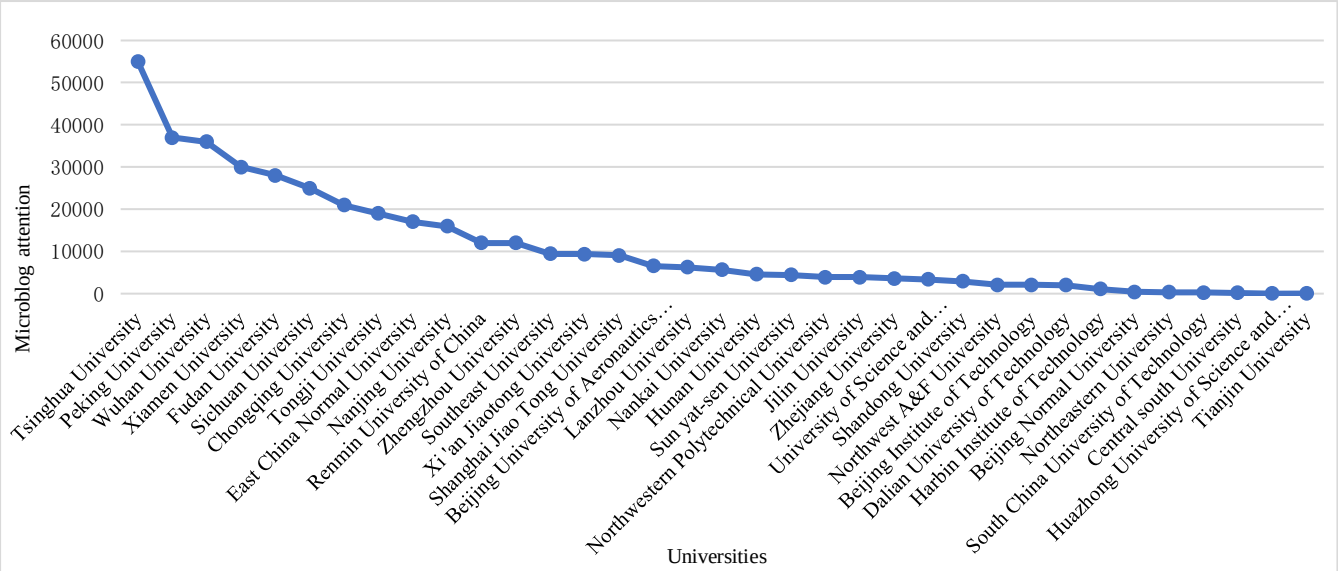

Figure 2.7 – Microblog attention ranking of thirty-five "double first-class" university libraries

Source: formed by the author

Research results of WeChat. Among the 42 "double first-class" universities, 41 universities have set up their own WeChat public accounts to push library information to users from time to time. Only the China Agricultural University library has not set up its own WeChat public account.

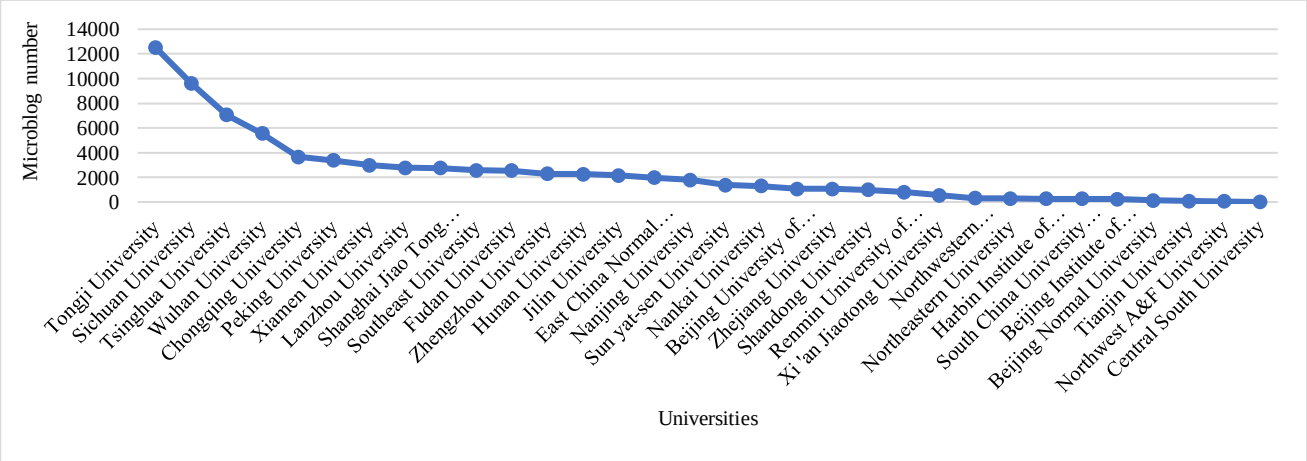

Figure 2.8 – The number of microblog posts issued by thirty-five "double first-class" university libraries

Source: formed by the author

According to the investigation and research on public accounts, the knowledge service marketing promotion of the Peking University library takes first place in the "double first-class" university library, with a frequency of at least four times a week, followed by the Tsinghua University library. In terms of the timeliness of WeChat message consultation and feedback, among the 41 university libraries, 7 (17.07%), 11 (26.83%), 21 (51.22%) and 21 (51.22%) libraries replied within 1 day, 3 days, 7 days and 30 days respectively.

Through a network search and website search, we found that only the Peking University Library, Tsinghua University Library and Lanzhou University Library and the library of the University of Electronic Science and Technology of China officially released a series of short videos. However, Beijing Normal University, Zhejiang University, Xiamen University Library and Southeast University Library publicize library knowledge service by means of promotion. An example is the creative short film "The Journey of the Gray Wolf Library" of Zhejiang University Library, which vividly presents the library's knowledge services, such as patent consultation, science and technology update, checkout and reference searches to users through humorous sketches.

Tsinghua University's "falling in love with the library" series is composed of a trailer and five official short films. The trailer mainly introduces the old library and Shaw Hall of Tsinghua University Library. Each of the latter five chapters contains a complete library service theme, including knowledge service contents such as information retrieval and knowledge space service. This series of short videos won first place in the 10th IFLA International Marketing Award. In addition, according to the data of the number of visits to the microfilm of "Falling in Love with the Library" (Table 2.10), the microfilm marketing of Tsinghua University Library has realized the purpose of knowledge service marketing and achieved impressive results.

Research results of website. In 42 "double first-class" universities, except the Central University for Nationalities library which does not list open knowledge service in the "services" column, the university library website column contains "subject service" (or "subject librarian") and science and technology novelty search, such as knowledge service, and puts it on the website in more eye-catching ways to facilitate the

location of the query. To study the specific content of knowledge services in colleges and universities, the author conducted an investigation on the specific knowledge services of marketing and promotion of the websites of 42 "double first-class" university libraries, and the results are shown in Table 2.11.

Table 2.10 – Statistics of visitors of "love library" microfilm

	Youku (Video web site)	iQIYI (Video web site)	The microbloggin g forwarding	Micoblog comments	Library bulletin access statistics
Microfilm	184078	20049	894	344	14241
Total	219606				
Average	7320 views/day				

Source: formed by the author

The survey shows that 42 "double first-class" university libraries have carried out publicity and promotion of knowledge literacy education (including information retrieval training lectures, etc.) and knowledge service content of science and technology searches. In addition, libraries of 15 "double first-class" universities, including Peking University, China Agricultural University, Nankai University, Tongji University, Shanghai Jiaotong University, Dalian University of Technology, Ocean University of China, Xi'an Jiaotong University and Chongqing University, have set up a special column on "intellectual property information services." The libraries of Beijing Institute of Technology, Tianjin University, Tongji University, Zhejiang University, Huazhong University of Science and Technology, Lanzhou University and Zhengzhou University provide detailed and targeted knowledge services such as "information analysis and research service."

Based on the 4I principle of network-integrated marketing, the "pyramid" three-dimensional communication model, and the network research results of the university library knowledge service marketing promotion power model, this paper discusses and verifies the following hypotheses.

Considering H1, microblogs and WeChat are widely used in the marketing and promotion of knowledge services in university libraries, which is consistent with the theoretical hypothesis. Therefore, the H1 hypothesis is accepted. In the survey, among the 42 "double first-class" universities in China, seven have not opened accounts, three

are personal accounts, the remaining 32 university libraries have microblog accounts officially certified by Sina, and 42 university libraries have microblogs, accounting for approximately 83%. Of the 42 "double first-class" universities, one university built its version of a library WeChat account, and one did not establish its own official WeChat account. This shows that the university library has realized that the number of users of media technology (microblogs and WeChat) in the dynamic elements is large, and the installation and maintenance costs are low. It is a better platform for the marketing and promotion of knowledge services.

Table 2.11 – Survey of marketing and promotion of knowledge Service content of "double first-class" university library website

Content	Knowledge literacy education	Subject service	Intellectual property information services	Intelligence analysis and research services	Science and technology novelty search	Knowledge space service
The number of universities	42	42	16	9	42	38
Proportion (%)	100	100	38	21.4	100	90.5

Source: formed by the author

Considering H2, the number of people who pay attention to micro media in the library does not increase with the higher popularity of the university. The survey results show that Zhejiang University and Shanghai Jiao Tong University, the top five universities in China, have only 3,599 and 9,076 microblog followers, which is inconsistent with their high popularity. This is not consistent with the theoretical hypothesis, which is rejected.

Considering H3, the earlier the university library opens microblogs and WeChat, and the higher the number and frequency of knowledge service articles, the easier it is to attract more users' attention, which is consistent with the theoretical hypothesis. Therefore, the H3 hypothesis is accepted. The top seven university libraries in terms of microblog volume have more than 2,900 blogs. Among them, six libraries also rank among the top seven in terms of microblog attention, and all of them have more than 18000 persons. The reason is that a sufficient number of articles can give users more

novel and rich content, and a higher publishing frequency can ensure the timeliness of the content to maintain stickiness to existing users and attract new users. It shows that the rich resource reserve and service content in the dynamic elements can improve user loyalty and satisfaction, and then increase the degree of communication.

Considering H4, the faster the feedback response of colleges and universities to users' message consultation on microblogs and WeChat, the easier it is to attract and keep users, which is consistent with the theoretical hypothesis. Therefore, the H4 hypothesis is accepted. In the research on the timeliness of consultation and feedback, the number of university libraries that replied by microblogs or WeChat within one day highly correlated with the number of people concerned by microblogs of university libraries. The speed of feedback consultation is closely related to the attention of university libraries to "micro media" but is also reflected in the number of documents and service awareness. It shows that a good user experience in dynamic elements can increase user comfort and loyalty.

Considering H5, the launch of microfilm of knowledge service makes it easier to establish the brand image of a university library, which is consistent with the theoretical hypothesis. Therefore, the H5 hypothesis is accepted. The production of micro videos is difficult and costly. It is found that only 4 of the 42 university libraries produce microfilms, and only 3 of them upload to the commercial broadcasting platform. However, its influence and scope cannot be ignored. Taking the series of microfilms shot by Tsinghua University Library as an example, it won first place in the 10th IFLA International Marketing Award. The average daily broadcast volume of the microfilm series is up to 7320 people, which played a significant role in promoting the popularity of Tsinghua University Library.

Considering H6, the marketing awareness and concept of knowledge service of university librarians cannot be obtained through network research. According to Zheng Wenhui's (2019) empirical survey, in 30 university libraries, only 23.3% of librarians have a correct understanding of library marketing or realize that library marketing is the most fantastic way to introduce marketing ideas to achieve library service benefits. This shows that the knowledge service marketing consciousness of university librarians is not

high as a whole. Based on the above relevant literature, the result is not consistent with the theoretical hypothesis. Therefore, the H6 hypothesis is rejected.

Considering H7, university libraries have generally opened a column of "knowledge service" on their website home page and refined the service, which is consistent with the theoretical hypothesis. Therefore, the H7 hypothesis is accepted. Forty-two "double first-class" university libraries have publicized and promoted their knowledge literacy education (including training lectures on information retrieval) and knowledge service content of scientific and technological novelty search. Among them, 7 university libraries have opened up more detailed and targeted knowledge services such as «information analysis and research service». In the more mature website service than "micro media" university libraries have established a relatively perfect knowledge service marketing system. This shows that most colleges and universities are able to do a good job in the marketing and promotion of knowledge services through micro media.

Conclusion to the Chapter 2

1. With the continuous expansion of the scale of GFHE, the government and universities should strengthen cooperation, actively improve the use efficiency and management level of funds, reduce «W-shaped» fluctuations, and improve the comprehensive efficiency of GFHE performance. There is a particular gap between the west and the national level, and the gap between the western and the eastern area is the largest. The guidance of national policies and the grasp of opportunities urge them to pay more attention to the funding in higher education and commit themselves to the efficient development of higher education quality, to cultivate more excellent talents to meet the needs of the rapid growth of the regional social economy.

2. With the «Belt and Road» policy, Shanxi and Chongqing have gained considerable growth in higher education, and the quality level has been rapidly improved. Class II «medium efficiency» provinces and three areas have both. It is noteworthy that Beijing, as the center of China's politics, economy and culture, also belongs to class II «medium efficiency», which indicates that Beijing is insufficient in the allocation and utilization of GFHE resources, showing problems such as excessive input of resources

and low input-output efficiency. Moreover, as economically strong provinces, Zhejiang Province and Guangdong Province also offer a low level of GFHE performance. The reason for its low efficiency is that the expansion speed of the GFHE fund scale does not keep a good fit with the improvement of quality. Class I «low efficiency» is mainly concentrated in the western area. The main reasons for its low efficiency are an underdeveloped economy, common scale of GFHE, and imperfect development of the higher education system. At the same time, the provinces whose SE has not reached the optimal scale have the problems of mismatch and too much or too little funding in the configuration and development needs of GFHE.

3. In eastern China, the per capita GDP (coefficient = 0.4942, $P < 0.1$) and the degree of urbanization (coefficient = 0.4721, $P < 0.05$) are the favorable factors affecting the performance of GFHE, while the student-teacher ratio of higher education institutions (coefficient = -0.0738, $P < 0.1$) is the unfavorable factor. The proportion of employees with a college education or above, the proportion of government financial expenditure in regional GDP. The proportion of tertiary industry output value in GDP in each province has no significant impact on in Central China. In central China, the degree of urbanization (coefficient = 0.2551, $P < 0.05$) is the favorable factor affecting the performance of GFHE, while the ratio of students to teachers in higher education institutions (coefficient = -0.3346, $P < 0.1$) and the proportion of tertiary industry output value in GDP of each province (coefficient = -0.3762, $P < 0.01$) are the unfavorable factors The ratio of employees with a college education or above and the proportion of government expenditure in regional GDP have no significant impact. Western China. In western China, the proportion of employed persons with a college education or above (coefficient = -0.1185, $P < 0.05$), the balance of government expenditure in regional GDP (coefficient = -0.3017, $P < 0.1$), and the ratio of tertiary industry output value in GDP of each province (coefficient = -0.1590, $P < 0.1$) are the unfavorable factors, and the per capita GDP The degree of urbanization and the ratio of students to teachers in higher education institutions have no significant impact on it.

4.Application of Input-output Performance Evaluation Method in Discipline Construction. Envelopment analysis method and matrix analysis method, it can be seen

that although the analysis results are different, they are generally consistent. Combining the two analysis methods, we can make an in-depth study on the discipline construction performance of each discipline group and draw a more scientific conclusion. G4 and G11 have high input and high output. After envelope analysis, they have achieved scale efficiency and technology efficiency. Therefore, the discipline construction performance of these two discipline groups is the best, and they are in the first echelon of the University. G7, G13, G18 and G19 have high input and output. After envelope analysis, they have also achieved scale effectiveness and technology effectiveness, and are in the second echelon of the University. The discipline construction of the seven discipline groups G20, G1, G2, G8, G9, G10 and G17 has low input and output. Through envelope analysis, it has also achieved effective scale and technology, and is in the third echelon of the University. G5 discipline construction has low investment and low output. It has achieved effective technology and not effective scale, but the scale income is increasing, which is in the fourth echelon. G14, G15 and G16 disciplines have high input and output, fail to achieve effective scale, and the return on scale is decreasing, so they are in the fifth echelon. The input and output of G3 discipline construction are low, the scale is not effective, and the return on scale is decreasing, which is in the sixth echelon. G12 discipline construction has high input and low output, does not achieve effective scale, and the scale effect decreases, and is in the seventh echelon.

5.The university library has realized that the number of users of media technology (microblogs and WeChat) in the dynamic elements is large, and the installation and maintenance costs are low. It is a better platform for the marketing and promotion of knowledge services. The rich resource reserve and service content in the dynamic elements can improve user loyalty and satisfaction, and then increase the degree of communication. A good user experience in dynamic elements can increase user comfort and loyalty. It is found that only 4 of the 42 university libraries produce microfilms, and only 3 of them upload to the commercial broadcasting platform. However, its influence and scope cannot be ignored. In the more mature website service than «micro media» university libraries have established a relatively perfect knowledge service marketing system.

CHAPTER 3. THE FUTURE TRENDS OF INNOVATIVE PROCESSES IN HIGHER EDUCATION INSTITUTIONS

3.1. The strategy of using artificial intelligence as a basis for introducing innovations in the management and development of higher education institutions

Artificial intelligence (AI) is an important driving force of a new round of scientific and technological revolution and industrial transformation, which is profoundly changing people's way of work, life and studying. As the main position of scientific and technological innovation and personnel training in the field of artificial intelligence, universities are also the main places of curriculum education activities. The continuous development of AI industry promotes the reform of AI curriculum education, and constantly improves the quality and ability of talents in AI industry. The novelty of this study is that, taking the development of AI major or AI College in Chinese universities as the research point, this paper deeply studied and analyzed the causes of the formation of AI specialty and college, the construction status quo, the existing problems and countermeasures of professional education. At present, the existing problems of AI major and college mainly include: the lack of first-class discipline status of AI, the lack of systematic curriculum, the shortage of AI teachers, and the lack of expansion of scientific and technological innovation field. In this regard, colleges and universities can promote the continuous improvement of the major and college of AI and promote the development of AI and economic society by strengthening the establishment of first-class disciplines of AI, improving the discipline layout of AI, establishing professional AI teachers, and constantly exploring the related scientific and technological innovation fields of AI. The deep integration will effectively promote the development of AI industry, so as to promote the healthy development of China's new generation of AI.

The joint research center of knowledge and intelligence of Tsinghua University and Chinese Academy of engineering and the selection base of Wu Wenjun AI science and technology award of China AI society jointly released the «2019 artificial

intelligence development report». The report covers 13 sub fields of AI, including machine learning, knowledge engineering, computer vision, natural language processing, speech recognition, computer graphics, multimedia technology, human-computer interaction, robot, database technology, visualization, data mining, information retrieval and recommendation. In April 2019, the Ministry of education of the people's Republic of China issued the notice of the Ministry of education on publishing the filing and examination and approval results of undergraduate majors in colleges and universities in 2018. A total of 35 universities in China have won the first batch of qualification for the construction of new AI majors (Table 3.1).

Among the first batch of 35 universities to obtain the qualification of AI specialty construction, there are 4 universities in Beijing, namely University of Science and Technology Beijing, Beijing Jiaotong University, Beihang University, and Beijing Institute of Technology. The Ministry of education's approval list shows that these majors belong to the engineering and learning category, with a four-year study period and are specially labeled as «new majors». In addition, closely related to the development of AI industry, 101 universities have newly added robot engineering specialty, 96 universities have newly established intelligent science and technology specialty, and 50 universities have added intelligent manufacturing engineering specialty.

On March 3, 2020, the Ministry of education of China announced the results of the filing and approval of undergraduate majors in general colleges and universities in 2019. Among the newly registered undergraduate majors, the AI major has the most newly added. 180 colleges and universities, including Renmin University of China, Fudan University, Beijing University of Posts and telecommunications, China Agricultural University and Beijing University of chemical technology, have added «AI» major. In addition, «Intelligent Manufacturing Engineering», «intelligent construction», «intelligent medical engineering», «intelligent perception Engineering» and other related majors in the intelligent field are also popular in the list of newly registered and newly approved undergraduate majors in colleges and universities.

Table 3.1 – List of 35 universities with AI major in 2019

University	Province/city
Beihang University	Beijing
Beijing Jiaotong University	Beijing
University of Science and Technology Beijing	Beijing
Beijing Institute of Technology	Beijing
University of Electronic Science and Technology of China	Sichuan
Northeastern University	Liaoning
Southeast University	Jiangsu
Harbin Institute of Technology	Heilongjiang
Hunan Institute of Engineering	Hunan
South China Normal University	Guangdong
Jilin University	Jilin
Jiangsu Universityof Science and Technology	Jiangsu
Jiangxi University of Science and Technology	Jiangxi
Lanzhou University	Gansu
Nanjing University	Jiangsu
Nanjing University	Jiangsu
Nanjing University of Information Science & Technology	Jiangsu
Xiamen University	Fujian
Shandong University	Shandong
Sichuan University	Sichuan
Tianjin University	Tianjin
Tongji University	Shanghai
Wuhan University of Technology	Hubei
Xidian University	Shanxi
Xi'an Jiaotong University	Shanxi
Northwestern Polytechnical University	Shanxi
Southwest Jiaotong University	Sichuan
Changchun Normal University	Jilin
Zhejiang University	Zhejiang
North University of China	Shanxi
Zhongyuan University of Technology	Henan
Chongqing University	Chongqing
Anhui Polytechnic University	Anhui
Dalian University of Technology	Liaoning
Shanghai Jiao Tong University	Shanghai

Source: formed by the author

AI is the general name of all theories and technologies that use modern computing and learning theories and methods to analyze and process the real world's language, words, sounds, images, videos and other signals, including the analysis and processing of human brain activity signals, so as to achieve the intelligent perception and

recognition of the real world, and control the real world according to the feedback control of human cognitive behavior(Cope B et al 2020).This major aims to cultivate professionals who master the theory and engineering technology of AI.

It studies the theories and methods of machine learning, deep learning framework, tools and practice platform, natural language processing technology, speech processing and recognition technology, visual intelligence processing technology, and the most cutting-edge theoretical methods in the international AI field, so as to cultivate the professional skills and literacy of AI to construct professional thinking, professional methods and professional smell to solve scientific research and practical engineering problems. This major provides students with in-depth learning practice platform and scientific research practice projects, and creates professional talents with scientific spirit and practical ability. Graduates will have the ability to engage in scientific research, technical research and development and professional teaching in computer and AI related fields.

In 2019, the Ministry of Education approved the first batch of 35 universities to enroll students, and in 2020, 180 universities were approved to open AI major. As this major is a new major, the curriculum system mainly relies on the main disciplines of computer science and technology, and combines with similar majors such as information engineering, electronic science and technology, control science and technology, information and computing science to construct the curriculum system of AI. The curriculum mainly includes four parts: basic courses of general education, basic courses of major disciplines, main professional courses and main practical links. Each university also combines its own professional characteristics to set up relevant key training direction or characteristic courses, such as Southeast University (table 3.2).

In April 2018, the overseas edition of people's Daily reported that the rapid development of Classification of AI curriculum system in recent years and the demand characteristics of industry talents have led to a huge gap of Classification of AI curriculum system talents. There is a gap of more than 5 million Classification of AI talents in China in 2018. In the first 10 months of 2017, the demand for talents has nearly doubled in 2016 and 3.5 times in 2015, with an annual compound growth rate of more

than 200%. In 2019, 35 universities in China began to enroll students majoring in AI. Among the first batch of 35 universities, 13 were enrolled according to engineering experimental classes, computer science, automation and other major categories.

Table 3.2 – Classification of AI curriculum system offered by AI major in universities

Classification of AI curriculum system	Courses
Basic course of general education	Cultural quality education courses, College English, college physics, engineering mathematical analysis, geometry and algebra, probability theory and stochastic process
Basic courses of major disciplines	Programming basis and language, analog and digital logic circuit, discrete mathematics, data structure basis, automatic control principle, optimization method
Major courses	Introduction to artificial intelligence, pattern recognition, machine learning, knowledge representation and reasoning, digital signal processing, digital image processing, introduction to database
Main practical parts	Hardware experiment, machine learning method curriculum design, computer vision curriculum design, deep learning curriculum design, extracurricular research and practice, production practice, graduation project
Series of seminar courses (including freshmen Seminar)	Seminar type elective courses: introduction to artificial intelligence theory and application, combinatorial mathematics, operational research, advanced data structure, computer graphics, deep learning and application, automatic planning, multi-agent system, unmanned driving technology, voice information processing; 2. Discussion + design courses: language course design, hardware experiment

Source: formed by the author

When they were in their second or third year of University, the specific professional direction would be determined according to students' learning interest and academic achievements. The enrollment quantity of AI major in these 13 colleges and universities cannot be counted in detail. In addition, the other 12 places have clearly admitted students according to the major of AI. According to the existing data analysis, the number of existing enrollment institutions tends to be stable, and some colleges have a small increase (table 3.3).

In 2020, there will be 180 new colleges and universities with AI major enrollment. With the increasing number of newly established AI majors, the number of students will

double in the short term. In 2020, the number of undergraduate students of AI major is roughly estimated to reach more than 17000. According to the current social demand for this kind of talents is still far from enough. At present, there are only other AI related majors to make up for it. At the same time, we also need to take into account the impact of factors such as the choice of graduate students for further study, going abroad and other factors on the relationship between social supply and demand. Since August 2020 is the second year for the enrollment of AI in China, there are no graduates so far. Therefore, it is impossible to carry out statistical analysis on the graduation destination of this major students.

Table 3.3 – Enrollment of AI major

University	province/city	2019	2020
Anhui Polytechnic University	Anhui	60	75
Zhongyuan University of Technology	Henan	48	50
Changchun Normal University	Jilin	132	200
Jiangxi University of Science and Technology	Jiangxi	49	50
Jiangsu University of Science and Technology	Jiangsu	60	60
Northeastern University	Liaoning	117	120
Hunan Institute of Engineering	Hunan	63	65
South China Normal University	Guangdong	50	50
Nanjing University	Jiangsu	80	80
Nanjing University	Jiangsu	30	30
Xidian University	Shanxi	146	150
Chongqing University	Chongqing	30	30
Total		865	960

Source: formed by the author

According to the report on the development of China's new generation of AI released in 2019, more than 30 universities in China have established AI colleges or research institutes, and 75 universities have independently set up 89 secondary disciplines or interdisciplinary subjects related to AI. Based on the existing research advantages and characteristics, each university has set up corresponding AI colleges or research institutes. Overview of the establishment of AI college as of June 2019, a total

of 28 colleges and universities have set up AI colleges or related colleges. Some colleges and universities only set up AI research institutes, such as Tsinghua University, Peking University, Harbin Institute of technology, Shanghai Jiaotong University, Tongji University, Suzhou University, et al which are not included in the article. For some vocational and technical colleges, such as the AI college set up by Jiangxi University of Applied Science, the statistics are not carried out. For some colleges and universities, Hunan University, for example, did not conduct statistics. From the statistical data, most of the colleges are called AI colleges. In addition, some colleges and universities have the names of intelligent engineering college or intelligent science college, such as Sun Yat-sen University and National University of Defense Technology. In addition, from the name of the college, some AI colleges are jointly established by universities and enterprises, which is more conducive to the cooperation of industry, university and research. For example, the iFLYTEK Artificial Intelligence college jointly established by Chongqing University of Posts and Telecommunications and iFLYTEK, Tencent cloud AI college established by Shandong University of Science and Technology, Liaoning University of Engineering and Technology, Shenzhen University and Tencent, Beijing Normal University and China Electronics Technology Group artificial intelligence college established by Beijing Normal University and China Electronics Technology Group, Gaoling Schoolof artificialintelligence established by Renmin University of China and Hillhouse capital, et al. From the time of establishment, there are 4 in 2017 and 17 in 2018, and only in the first half of 2019, 7 universities have established AI colleges. For some colleges and universities, in order to effectively integrate research forces, promote scientific research and accelerate the transformation of scientific and technological achievements, AI research institutes have also been set up, such as Nanjing University, Southeast University, Beijing Normal University, Hangzhou University of Electronic Science and technology, et al. Colleges and universities are the important bases of personnel training, which have the functions of personnel training, scientific research, social service and cultural inheritance and innovation. The attributes of knowledge, public welfare, industry and service determine that the main object of university management is to educate people. The education of

university is mainly realized through the college composition of different majors or fields. Similarly, for the construction of AI college, education is the fundamental task.

The following mainly analyzes and discusses the current construction situation of AI college from the aspects of establishment mode, teachers source, specialty setting, discipline setting and development characteristics.

At present, there are four ways to establish artificial intelligence colleges in Universities:

1) changing the name of existing colleges, for example, Nanjing University of traditional Chinese medicine renamed the former college of information technology as the college of AI and information technology;

2) jointly established with enterprises, such as Shenzhen University and Tencent jointly established Tencent cloud AI college. Renmin University of China and Gao Hillhouse Capital has jointly established Gaoling School of Artificial Intelligence;

3) It has set up an independent AI college, such as Nanjing University;

4) It has cooperated with other colleges, such as Nanjing University of Aeronautics and Astronautics, which is the school of computer science and technology and the Academy of AI.

According to the advantages, characteristics and different ways of establishing AI colleges, the sources of teachers are also different. There are mainly three kinds of teachers:

1) Teachers are allocated from existing colleges, such as Nanjing University Artificial Intelligence College, which is from the existing computer department;

2) Through the integration of teachers related to AI in different colleges, such as Sun Yat-sen University intelligence College of engineering, which integrated teachers from the school of electronics and information engineering and school of data science and computer (Software College) to form a new faculty of intelligent engineering;

3) Some colleges and universities that jointly set up AI college with enterprises set up teachers through cooperation with enterprises, such as iFLYTEK AI college of Chongqing University of Posts and Telecommunications, Tencent cloud of Shenzhen University Institute of AI, et al (table 3.4).

Table 3.4 – Enterprises that cooperate with universities or jointly build AI colleges

Enterprises	Jointly build AI colleges
IFLYTEK CO.LTD.	school of applied law in Southwest University of Political Science & Law; IFLYTEK Artificial Intelligence school of Chongqing University of Posts and Telecommunications; IFLYTEK Artificial Intelligence school of Nanning University; Big data and Artificial Intelligence school of Anhui Institute of Information Engineering; Artificial Intelligence school of Jiangxi Institute of Applied Science and Technology; School of artificial intelligence, Chongqing Science and Technology College
Tencent Technology (Shenzhen) Co., Ltd	Tencent Institute of artificial intelligence, Shenzhen University; Tencent cloud Artificial Intelligence College of Liaoning University of engineering and technology; Tencent cloud Artificial Intelligence College of Shandong University of science and technology; Tencent cloud Artificial Intelligence College of Liaocheng University
Baidu Online Network Technology (Beijing) Co., Ltd	College of artificial intelligence, Jilin University; Xiangjiang College of artificial intelligence, Hunan Normal University; Artificial Intelligence College of Henan University of Finance and Finance.
Beijing Kuangshi Technology Co., Ltd	School of artificial intelligence, Nanjing University; School of artificial intelligence, Xi'an Jiaotong University
Shenlan Technology (Shanghai) Co., Ltd	Central South University Shenlan Institute of technology and artificial intelligence; Shenlan Institute of artificial intelligence, Jiangsu Institute of Technology

Source: formed by the author

The construction of the college is inseparable from the opening of undergraduate majors. At present, in addition to the AI specialty set up by the 35 colleges and universities approved by the state this year, it also includes some existing specialties, such as intelligent science and technology, data science and big data technology, and some characteristic self-designed specialties, such as medical information engineering.

The development of the college is inseparable from graduate education. At present, AI does not have its own first-class discipline. Therefore, in view of this situation, most colleges and universities have two main ways to set up disciplines: one is to set up AI direction by relying on other first-class disciplines, such as establishing AI direction under the secondary disciplines of computer software and theory or computer application, or interdisciplinary direction; the other is to set up secondary

disciplines by relying on other first-class disciplines, such as pattern recognition And intelligent system, intelligent information processing, et al.

More and more colleges and universities have set up AI colleges. In the process of building AI colleges, colleges and universities have given full play to their advantages and characteristics, which are mainly reflected in:

1) Interdisciplinary, for example, the school of intelligent engineering of Sun Yat-sen University focuses on the interdisciplinary direction of intelligent transportation, intelligent medicine and intelligent manufacturing;

2) School characteristics, such as intelligent science of University of Defense Science and technology. The Institute focuses on the development of intelligent robot, intelligent unmanned platform, intelligent cluster ammunition, UAV cluster system, manned unmanned cooperative system and other national defense characteristic directions;

3) The advantages of Nanjing University, such as machine learning and data mining, intelligent system and application, focus on the development of these two research directions;

4) industry university research cooperation, such as Chongqing post and telecommunications IFLYTEK artificial intelligence college established by the university mainly focuses on the development of intelligent information processing, network security and control, mobile Internet big data and other enterprises' concerns, aiming at the technical needs urgently needed by iFLYTEK.

Although the new generation of AI development plan issued by the State Council of China in July 2017 clearly puts forward «promoting the construction of first level disciplines in the field of AI», the Department of degree management and graduate education of the Ministry of education of the people's Republic of China issued a new catalogue of degree granting and personnel training disciplines in April 2018. There are 111 first-class disciplines in China, but there is no AI discipline. The lack of the first level discipline status of AI has two main adverse effects: on the one hand, it leads to the simplification and fragmentation of personnel training. At present, the vast majority of AI related enrollment is still placed in the computer college or automation college.

Students learn more computer and automation professional knowledge, but less AI related knowledge, resulting in the simplification and fragmentation of personnel training, which is not conductive to the systematic training of AI talents. For example, Nanjing University AI personnel training is put in the computer specialty, the implementation of a wide caliber talent training mode. Among the 150 credits required by the major, the general education course accounts for about 60 credits, and the graduation course of entrepreneurship and innovation has about 15 credits, and the credit related to AI is very few. As a result, the cultivation of AI is reduced to a high-level science popularization of AI related knowledge for students. It is difficult for students to master the advanced knowledge of AI, to solve the practical problems faced by enterprises, and to meet the development requirements of intelligent industry, which greatly reduces the training effect. On the other hand, it is not conducive to the collection of subject resources. Generally speaking, the first level discipline is supported by several independent, clear and mature secondary disciplines, and forms an independent curriculum system, which can cover all aspects of discipline development, and is conducive to the formation of talent echelon. However, the lack of the first level discipline of AI limits the development and growth of secondary disciplines, making it difficult to gather many discipline resources and restricting the pace of development of AI.

The in-depth demonstration of the connotation of the AI discipline and the promotion of the construction of the first level discipline of AI have been included in the recent work priorities of the Ministry of education. In fact, in the early stage, the Chinese society of AI has cooperated with universities, enterprises, relevant societies and scientific research institutions to carry out research and demonstration, and wrote the first level discipline demonstration report of «intelligent science and technology». The report discusses the establishment of «AI» first-class discipline, and puts forward opinions and opinions on the construction of related secondary disciplines. At present, AI has entered a stage of rapid development, and many countries have upgraded it to national strategy. For example, the United States released the national strategic plan for AI research and development and «preparing for the future of AI»; the United Kingdom

released the survey report of «AI, opportunities and impacts of future decision-making» and «robotics and AI»; Canada launched the «Pan Canadian AI strategy», et al. He competition among countries in the field of AI is becoming increasingly fierce. The essence of the competition is the competition of talents. The establishment of the first level discipline of AI is conducive to gathering more funds and projects into the field of AI, attracting a large number of outstanding talents to devote themselves to the teaching and scientific research of AI, and to the systematization, standardization and specialization of personnel training in this field. This will greatly meet the strong demand for AI talents in the current society, and will also promote China's new round of global science and technology Take the lead in the world in competition. Therefore, the state should fully consider the development trend of AI and the demonstration of its first level discipline by relevant units, accelerate the pace of the construction of the first level discipline of AI, and strive to obtain the initiative and leadership in the new round of international competition.

The curriculum is lack of systematicness. Curriculum refers to the system of various disciplines and various educational and teaching activities constructed by schools according to certain educational purposes (Crowe DL et al 2017). Whether the curriculum is reasonable or not directly affects the quality of personnel training. At present, the curriculum of AI talent training in Chinese universities is lack of systematicness, which is mainly reflected in the following three aspects: firstly, due to the large number of AI related majors, colleges and research institutes in China in recent years, the relevant courses are less offered, and the teaching system is in the initial stage, which leads to the lack of systematicness of the curriculum setting (Goralski MA and Tan TK, 2020). Secondly, due to the lack of a unified talent training standard for AI related majors in China, colleges and universities basically set up courses based on their own advantages and characteristic disciplines, resulting in a strong randomness in the curriculum setting of AI, and the quality of courses is uneven. Third, AI related courses emphasize science and engineering, but ignore humanities (hassignol MK et al). At present, AI related courses in Chinese colleges and universities mainly involve mathematics, computer science, cognitive science and other science and engineering

subjects, but lack of humanities related courses. However, foreign AI related courses reflect the liberal arts and science. For example, Carnegie Mellon University's AI related courses, in addition to mathematics, computer science and engineering content, but also to learn anthropology, ethics and art and other humanities. Due to the lack of systematicness in the training course of AI talents, the quantity and quality of training talents are difficult to meet the market demand. The lack of innovation in talent training mode, the urgency of AI professional training mainly stems from the strong demand for AI talents caused by the vigorous development of AI industry (Kim YS 2018).

There is a large gap of AI related talents in China, so it is urgent to strengthen the cultivation of AI professionals. According to the survey of AI colleges in Colleges and universities, there are mainly two forms of talent training mode of AI at present: one is «AI + X» training mode, which focuses on the cultivation of compound talents combined with the characteristics of interdisciplinary development. For example, China University of Petroleum (Beijing) implements «integration of undergraduate, master and doctoral students» in accordance with the concept of «characteristic discipline + AI»; Liaoning University of engineering and technology carries out the training of new engineering talents with «specialty + AI». The second is the training mode of «school enterprise cooperation and collaborative education». A number of colleges and universities have cooperated with relevant enterprises to jointly build an AI college, and carry out in-depth «industry university cooperation and integration of production and education» to cultivate talents more suitable for social needs. It is true that the above two types of training mode of AI professionals are worthy of full affirmation, but most universities are still actively exploring and have not yet formed a relatively mature talent training program. Zhu Zhiting believe that the technological development in the era of AI has brought qualitative changes and new challenges to the teaching content, teaching form, teacher-student relationship and educational philosophy. Therefore, the cultivation of AI professionals should keep pace with the times to meet the requirements of the era of AI. At present, because there is no unified standard of AI professional talent training objectives, positioning, training programs, different schools are practicing their own talent training programs, although it can reflect the school's school characteristics, but

the scientific nature and rationality of these AI talent training programs need to be further verified by practice, so it is still necessary to optimize and create new training mode of AI professionals.

Disciplines and majors are not only the important basis for the development of AI in universities, but also the key support for the development of AI (Cui Xiangjunand Ma Yangna ZX, 2011). At present, the College of AI of university should promote the construction of AI discipline and specialty around the two aspects of «improving the discipline layout» and «strengthening the specialty construction». The first is to improve the discipline layout of AI. Specifically, on the one hand, it is necessary to strengthen the cross integration of AI and related disciplines. These related disciplines not only include science and engineering disciplines such as computer science, control science, quantum science, mathematics, but also should pay attention to the humanities such as law, sociology, psychology and economics, so as to fully reflect the «technical attribute» and «social attribute» of AI; on the other hand, it is necessary to pay attention to the «technical attribute» and «social attribute» of AI According to the construction of the first level discipline of AI, from the perspective of the development trend of AI discipline, it is the general trend to establish the first level discipline in the field of AI. Therefore, it is necessary to build a good foundation for the establishment of first level discipline of AI in the future. Second, strengthen the construction of artificial intelligence. Combined with the practical background of "new engineering", we should focus on promoting the construction of "first-class undergraduate, first-class specialty and first-class talents" in AI. We should strengthen the deep integration of AI and professional education of related disciplines, and continue to implement the talent training mode of " AI + X"; we should scientifically set up relevant courses, which mainly refer to the arrangement of teaching subjects, various activities, sequence and teaching hours. Curriculum not only reflects the requirements of talent training, but also is an important carrier of talent training, which is of great significance to talent training in colleges and universities. Curriculum design is a systematic project, which should take into account the training objectives and discipline characteristics, and serve the establishment of students' complete knowledge and skills structure (Po-Hsuan Lin,

2018). To set up the course of talent training in the field of AI scientifically, we can start from the following three aspects: first of all, unify the talent training standards. The state can formulate a unified training standard for AI talents. On the basis of this standard, colleges and universities can establish professional basic courses, professional compulsory courses, professional elective courses and optional courses, which is conducive to the formation of an independent curriculum system and enhance the professionalism and systematicness of the courses. Secondly, increase the humanities curriculum. Whitehead once said, «technical education without humanistic education is incomplete, and without technical education, there is no humanistic education. Education should train students to be knowledgeable and skillful». At present, AI talents should not only understand technology, but also understand art, especially the ethics and morality of AI. Therefore, it is necessary to bring the contents of Humanities and arts into the course of artificial intelligence, so as to cultivate talents with rich knowledge. Third, encourage enterprises to set up relevant courses. Enterprises participate in the course offering, which not only helps to mobilize the enthusiasm of enterprises to participate in personnel training, but also enables students to face the most basic and practical problems of AI, and makes the students stand at the forefront of industrial development.

In May 2017, China's first intelligent engineering college was established in Sun Yat-sen University. In April 2019, the Ministry of education of China issued the notice of the Ministry of education on publishing the filing and examination and approval results of undergraduate majors in general colleges and universities in 2018. A total of 35 colleges and universities across the country have won the first batch of qualification for the construction of new AI majors. On March 3, 2020, the Ministry of Education announced the filing and approval results of undergraduate majors in general colleges and universities in 2019. Among the newly registered undergraduate majors, the «AI» major has the most newly added. 180 colleges and universities, including Renmin University of China, Fudan University, Beijing University of Posts and Telecommunications, China Agricultural University and Beijing University of chemical technology, have added «AI» major. Generally speaking, the main task of the "College"

is to teach and impart the basic theory and professional knowledge in the field of the discipline. The teaching objects include both undergraduate and graduate students, but mainly undergraduate students. The main task of the «Research Institute» is scientific research. Although there is teaching, the teaching object is graduate students, which is more professional. The establishment of AI colleges and research institutes marks that China's talent training in the field of AI has gradually moved towards systematization, standardization and specialization, which is beneficial to different levels of personnel training.

The cultivation of different types of talents is conducive to meet the diverse needs of society for talents. There is a shortage of related professional teachers. According to statistics, in terms of the proportion of AI talents with more than 10 years of experience in the United States, nearly half of them have more than 10 years of experience, while less than a quarter of them are in China. With the establishment of a number of AI related majors, colleges and research institutes in colleges and universities, the problem of lack of artificial intelligence teachers is increasingly apparent. Although some colleges and universities transfer teachers from communication engineering, computer, automation and other majors to teach AI related majors, to a certain extent, the shortage of AI teachers in the «quantity» problem has not been effectively solved. The loss rate of University AI teachers is increasing gradually, which makes the shortage of teachers more prominent. Due to the large gap of AI talent market, some enterprises attract university teachers with high salary and good research conditions. Some well-known enterprises in China not only introduce domestic university teachers, but also expand the introduction to foreign countries. For example, Baidu has introduced Wu Enda, director of the Artificial Intelligence Laboratory of Stanford University, to the company to engage in artificial intelligence research. Alibaba has recruited Wang Gang, a former tenured professor of Nanyang Polytechnic University in Singapore, to serve as the chief scientist of Ali's AI laboratory. With the further development, growth and maturity of AI industry, the competition for AI talents in the market is becoming increasingly fierce, and the shortage of university teachers will become increasingly serious.

Strengthening the construction of teaching staff, the quantity and quality of talents trained in colleges and universities have greatly affected the development of productivity, national economy, culture and education. The quality of talents training in colleges and universities often depends on the work of university teachers.Therefore, to strengthen the construction of AI teachers in colleges and universities and improve the overall quality of AI related professional teachers, we can mainly start from the following three aspects: first, normal colleges and universities set up AI related majors. Normal University is the best place to train teachers. Setting up AI specialty in normal colleges is conducive to the scientific and systematic training of teachers in this field. It can continuously supply teachers for colleges and universities and alleviate and make up for the shortage of teachers in the field of AI from the source. Secondly, teachers should be encouraged to participate in AI related training and visiting activities. Universities can organize teachers in the field of AI to participate in training in the field of AI in batches to improve their theoretical and knowledge literacy in the field of AI. Qualified colleges and universities can also organize teachers to study the frontier knowledge and advanced theory in the field of AI in foreign universities, so as to increase their knowledge and broaden their international vision(Pokrivcakova S 2019). Third, the introduction of high-level AI talents to teach in colleges and universities. On the one hand, colleges and universities can make full use of China's "Thousand Talents Program" and other policy resources to introduce a group of high-end talents in the field of AI to work in colleges and universities; on the other hand, colleges and universities can formulate rich talent introduction policies, give high-level AI talents generous salary, superior scientific research conditions, and good accommodation environment, so as to create a high-level teacher team.

The field of scientific and technological innovation still needs to be developed (Xiao M and Yi H 2020). As an important source of innovation in the field of AI technology in China, universities should be able to grasp the development trend of AI technology and further promote scientific and technological innovation in the field of artificial intelligence. From the perspective of the colleges and universities surveyed, they are mainly based on their own school running characteristics and advantageous

disciplines, focus on the frontier problems in the field of artificial intelligence, carry out research on AI related interdisciplinary, and further promote scientific and technological innovation in many fields. On the whole, existing AI colleges are more inclined to explore the application of AI technology in related fields, and may ignore the strategic technology of AI leading a new round of technological revolution and industrial transformation, which has a strong "head goose" effect of spillover (Zhang Maocong2018). Facts show that the new generation of AI is having varying degrees of influence on many other fields (Wang G et al 2020). Therefore, the College of AI of university should, on the basis of existing research, continue to explore the fields of scientific and technological innovation related to AI, pay close attention to the research on key core technologies of AI, and pay attention to strengthening the basic theoretical research of AI (Wartman SAC and C. Donald 2018). The social service system is not perfect. Serving the society is one of the basic functions of colleges and universities, and it is also the purpose of establishing the college of AI.

From the perspective of the colleges and universities AI colleges, they can combine their own school running characteristics, strengthen cooperation with relevant enterprises and local governments, and pay attention to promoting the social development of AI. Although it has achieved phased achievements in the key fields of intelligent manufacturing, intelligent education, intelligent medicine, intelligent agriculture, intelligent justice, intelligent finance and national defense security, it is still in the initial exploration stage, especially in the depth of transformation and demonstration application of scientific and technological achievements. Materialist dialectics tells us that everything has two sides. As a «double-edged sword», AI may bring potential risks to economic security and social stability while promoting economic construction and social development. For example, the rapid development of AI may bring many problems such as law and social ethics (Walsh K 2020). However, at present, the social service system of AI in China is not perfect. Therefore, in the process of promoting the social service of AI, colleges of AI in colleges and universities should carry out relevant research in advance to further help improve the social service system of AI.

At present, major developed countries have traditional advantages in the development of AI, with more core technologies and top talents (Zhang Y et al 2020). Therefore, China must attach importance to international exchanges and cooperation, learn from the advanced experience of other countries, and participate in relevant project research cooperatively. For example, the Institute of AI of Shanghai Jiaotong University takes the establishment of "international exchange center of AI and talent training base" as one of the development goals of the college; Shandong University and Nanyang University of technology of Singapore give full play to their respective discipline advantages and initiate the establishment of "international joint research Institute of AI "through the "2 + X" operation mode; when Tianjin Normal University established the AI college, Tianjin Normal University established the "International Joint Research Institute of AI ", It has jointly established the "Tianjin International Joint Research Center for AI and information processing" with Tianjin. It can be seen that colleges and universities pay attention to international development, actively seize the strategic opportunities for the development of AI, and strive to achieve new breakthroughs through the innovation and guidance of AI.

Universities should lead scientific and technological innovation in the field of AI (Zheng Jiehong2018). The innovation of AI is a system engineering, which needs to strengthen the cooperation of technology innovation and system innovation, and the deep cooperation of multi-agent. As AI has the characteristics of multidisciplinary synthesis and high complexity, it is necessary to enhance the "original" ability of the development of AI. On the one hand, it should pay attention to the basic theoretical research of AI, on the other hand, it should focus on the key core technology innovation of AI. Focusing on the scientific and technological innovation in the field of AI, the college of AI of university should start from the following aspects: first, strengthen the basic theoretical research of AI, focus on the major scientific frontier issues of AI, and focus on the research on relevant theories, methods, tools and systems of AI, so as to provide theoretical support for the transformation of AI paradigm. Third, we should not only focus on the key areas of AI innovation, but also focus on the key areas of AI innovation First class talents, high-level think tanks and strengthening international academic

exchanges and cooperation to promote the development of AI. The college of AI not only undertakes the task of personnel training and scientific research in this field, but also promotes the integration and development of AI and economic society. According to the composition of AI college, the University attaches great importance to the cooperation with relevant enterprises and local governments, focusing on the technology transfer and achievement transformation of AI. As AI is a high and new technology with a wide range of influence, with the rapid development of the new generation of AI, it will gradually have a profound impact on many fields of society(Luting JGM 2019). Therefore, the College of AI in colleges and universities should pay attention to strengthening the research on the service of AI to society, so as to promote the integration and development of AI and social related fields. It should be pointed out that due to the uncertainty in the development of AI, it also brings many potential risks and challenges to China's economy and society, such as possible legal, social ethics, employment and privacy security issues, which will affect China's economic security and social stability. Therefore, while vigorously promoting the intellectualization and modernization of social governance, the college of AI should, on the one hand, be alert to the potential risks of AI, establish an ethical and moral restraint and supervision mechanism, and resolutely say "no" to the "forbidden zone" of AI technology; on the other hand, it should closely contact with reality, strengthen targeted research and actively explore its possible negative effects To seek effective coping strategies and solutions to promote the development of AI to better serve the social development.

3.2. Risk management of credit projects in higher education institutions

Fund support is an essential pillar of enterprise and economic development, and bank loan is the primary channel for enterprise financing. Relevant data show that more than 62% of the business of Chinese commercial banks is credit business, so credit business is the primary profit source of Chinese commercial banks. However, in the development of the modern market economy, with the increasingly fierce market competition, the development of enterprises is facing more significant risks and

uncertainties. Therefore, there are also more significant risks in the loans provided by commercial banks. The risk brought by the loan business has become the main risk faced by Chinese commercial banks. With the continuous reform of China's commercial banks and the continuous improvement of the financial market, the management of credit risk has become an urgent problem for China's commercial banks. Although China's commercial banks have initially established a risk management system, it is still exploratory. Compared with the risk management system of commercial banks in developed countries, the risk management system of Chinese commercial banks is not perfect.

With the reform of China's higher education, private higher education has developed rapidly. The development of private colleges and universities is of positive significance to the reform of China's education supply and the improvement of the teaching quality of Chinese colleges and universities. In the outline of the national medium and long term education reform and development plan (2010-2020) promulgated by China, it is clearly stated that China needs to vigorously support the development of private education in many aspects in education reform and development, encourage all resources to invest in the higher education industry, and constantly improve the teaching quality and teaching level of China's higher education, Actively explore the development model of private higher education. Local commercial banks have also provided many financial services to develop China's private higher education. The loans provided to PHEI have increased rapidly in a short period. The rapid growth of loan mode has also brought potential risks to commercial banks.

While providing loans to PHEI, commercial banks must also strengthen risk management. Only in this way can they improve the profitability of commercial banks and realize the sustainable development of commercial banks. Effective risk management of commercial banks is the primary way and measure to avoid loan risk. Given the importance of risk management of commercial banks, this paper selects the debtor SQ University loan project of Z branch of HX Bank for risk management research, identifies and evaluates the project risk in combination with the actual situation

of the project, and puts forward targeted measures and suggestions for risk management in variety with the actual problem.

Let's study the risk analysis of private higher education loan projects by commercial banks, and construct a targeted evaluation system. Therefore, assumptions include:

H1: the loan projects of PHEI have different risk characteristics from enterprises.

H2: It is necessary for commercial banks to build a risk evaluation system for loan projects of PHEI.

H3: commercial banks build a risk assessment system according to the characteristics of PHEI, which can better provide services and effectively reduce their risks.

Taking the debtor SQ university loan project as a specific case, this study identifies the loan risk of private universities through the Delphi method. Further, it obtains the problems and deficiencies in the risk management environment, risk identification, management activities, and informatization through systematic evaluation.

Financial status of the debtor SQ university loan project. At present, the primary source of income of SQ universities is tuition and miscellaneous fees. From 2016 to 2020, tuition fees account for 82.72% - 88.56% of the total income of colleges and universities. From the perspective of expenditure, the primary support includes two parts: recurrent expenditure and constructive expenditure (Table 3.5). The total annual income of colleges and universities is about 190 million yuan.

Colleges and universities need to spend a lot of money every year, and need to borrow money from banks to solve the problem of capital gap. According to the estimation, the debtor SQ university plans to borrow 763 million yuan from the bank in the new campus construction project, with an annual repayment of 84.72 million yuan. It takes 14 years for the university to repay the bank loan. The total loan interest and principal and interest paid were 367753400 yuan and 1130753300 yuan respectively.

Table 3.5 – Proportion of income and expenditure of debtor SQ University (%)

categories		years				
		2016	2017	2018	2019	2020
sources income	miscellaneous fees	88.52	88.56	85.36	83.52	82.72
	school run enterprises	5.98	6.03	8.21	9.36	8.02
	real estate lease	3.52	3.45	4.41	4.99	7.12
	others	1.98	1.96	2.02	2.13	2.14
expenditure	teaching expenses	19.17	20.45	23.31	21.19	22.64
	faculty salaries	19.76	21.71	21.42	22.13	24.56
	administrative office expenses	15.35	13.75	17.29	12.81	21.33
	marketing and publicity	13.26	18.38	20.51	18.49	19.43
	constructive expenditure	32.61	25.89	17.44	25.36	12.07

Source: formed by the author

Questionnaire on loan projects of PHEI. Based on the project risk management theory, this paper sets up detailed investigation questions about China's guidelines on risk management of commercial banks, basic norms of enterprise risk management, and other relevant policies and standards, combined with work practice and the construction project of the new campus of SQ University.

Selection and distribution of respondents. Twelve people were selected to participate in the study. The specific personnel composition is five internal loan managers of HX Bank, three university project managers, and four sub-control departments of superior branches. In the risk survey, the anonymous survey method is adopted. Each person issues a questionnaire. A total of 12 questionnaires were distributed and recovered. Ten valid questionnaires are obtained from the questionnaire, from which the risks of loan projects of PHEI are summarized.

In the survey, the «Likert scale» is used to evaluate the risk elements. The debtor SQ is the risk assessment index of a university loan project. The risk elements are mainly investigated from five aspects, including 15 risk elements.

Composition of experts. In this survey, an expert group composed of 8 different experts was selected (Table 3.6).

Combined with the expert scoring tructure and the actual situation of the project, the risk management system is divided into five levels: management environment, risk assessment, management activities, information and communication, and internal

perspective. These five levels are used as hands, and then different detailed indicators are set under each level to form the risk management system.

Table 3.6 – Composition of experts

Numbers	Surname	Unit and position
1	Jiao	Project risk management manager of a bank PHEI
2	Li	University Loan Risk Management Manager of a bank
3	Shen	Loan project supervisor of a bank PHEI
4	Huang	Professor of financial management in a university
5	Zhang	Professor of financial management in a PHEI
6	Ma	Professor of financial management in a public university
7	Wu	Loan project supervisor of a bank PHEI
8	Fu	Loan project supervisor of a bank PHEI

Source: formed by the author

The risk management environment is mainly investigated and identified from the aspects of risk management organization structure, concept, human resources , and culture; In terms of risk assessment, investigation and identification are mainly carried out from the elements of indicators, systems, new business assessment, incompatible responsibilities , and authorization approval; In the management activities, the investigation is primarily carried out from two parts: performance appraisal and internal audit; In terms of information and communication, the study is primarily carried out through two factors: information system and internal communication of the bank; Internal supervision specifically includes bug.

Establish a hierarchy of factors. According to the setting of risk management factors, the specific situation of the debtor SQ University loan risk management index system established in the analysis and research is shown in Table 3.7.

Establish an indicator comment set. After completing the construction of the index system, this paper sets the index evaluation language set. Expressly, it is set as five risk levels A, B, C, D, and E, corresponding to 85-100, 70-84, 60-69, 40-59, and 0-39 points, respectively.

In the risk index system, there are significant differences in the importance and role of different index systems for the risk management effect of Z branch debtor SQ University loan project. Therefore, it is necessary to set the weight value of each quality

assurance in the index system. In determining weight value, the expert group scores, then takes the geometric average value, obtains the average score, finally calculates the importance of different indicators, establishes a judgment matrix, and finally calculates the weight values of primary and secondary indicators.

Table 3.7 – Risk management system of SQ University loan project, debtor of Z branch of HX Bank

Target layer	Factor layer	
	Primary index	Secondary index
Z branch debtor SQ University loan risk management	Management environment U1	Organizational structure U11
		Human resources U13
		Management philosophy U12
		Management culture U14
	Risk assessment U2	Evaluation index U21
		Evaluation system u22
		New business assessment U23
		Incompatible responsibilities U24
		Authorized approval u25
	U3 management activities	Performance appraisal U31
		Internal audit U32
	Information and communication U4	Information system U41
		Internal communication U42
	Internal oversight U5	Budget management U51
		Contract management U52

Source: formed by the author

Clarify the weight of primary indicators, and calculate the judgment matrix of primary indicators and specific weight values, as shown in Table 4.

Table 3.8 – Weight values of primary indicators

	U1	U2	U3	U4	W
U1	1	2	3	4	0.4632
U2	1/2	1	1	4	0.2407
U3	1/3	1	1	4	0.2219
U4	1/4	1/4	1/4	1	0.0743
U5	1/5	1	1	4	0.2605

Source: formed by the author

According to the calculated weight value λ Max = 4.0179, Cr = 0.0440 < 0.1, indicating that it has passed the consistency test.

Determination of the weight of secondary indicators the weight value and influence degree of each secondary indicator system under the five primary hands are shown in next tables, respectively.

Table 3.9 – Weight values of secondary indicators under risk management environment

U1	U11	U12	U13	U14	W
U11	1	4	1	5	0.3426
U12	1/4	1	1/4	3	0.2326
U13	1	4	1	5	0.3426
U14	1/5	1/3	1/5	1	0.1422

Source: formed by the author

The secondary indicators under the risk management environment are obtained through calculation λ Max = 4.0592, Cr =0.0197<0.1, the calculation results pass the consistency test and meet the requirements.

Table 3.10 – Weight value of each index under risk assessment

U2	U21	U22	U23	U24	U25	W
U21	1	3	1/2	2	4	0.2595
U22	1/3	1	1/5	1/2	2	0.0918
U23	2	5	1	3	5	0.4301
U24	1/2	2	1/3	1	3	01578
U25	1/4	1/2	1/5	1/3	1	0.0606

Source: formed by the author

The secondary indicators under risk assessment are obtained through calculation λ Max = 5.0680, Cr = 0.0151 < 0.1, the calculation results pass the consistency test and meet the requirements.

Table 3.11 – Weight values of indicators under management activities

U3	U31	U32	W
U31	1	3	0.2695
U32	1/3	1	0.1722

Source: formed by the author

The secondary indicators under management activities are calculated λmax = 4.0592, Cr= 0.0197<0.1, the calculation results passed the consistency test and met the requirements.

Table 3.12 – Weight values of indicators under information and communication

U4	U41	U42	w
U41	2	5	0.4792
U42	1/2	2	0.1791

Source: formed by the author

The secondary indicators of information and communication are obtained through calculation λ Max = 4.0592, Cr = 0.0197＜0.1, the calculation results passed the consistency test and met the requirements.

Table 3.13 – Weight values of indicators under internal supervision

U5	U51	U52	U53	U54	w
U51	1	3	1/2	3	0.2695
U52	1/3	1	1/5	3	0.1722
U53	2	5	1	5	0.4792
U54	1/2	2	1/3	1	0.1791

Source: formed by the author

Through calculation, the secondary indicators under internal control are obtained λ Max = 4.0592, Cr = 0.0197, the calculation results passed the consistency test and met the requirements.

By identifying risks, it is concluded that in the debtor's SQ University new campus construction loan project, there are mainly ten factors that may lead to loan risks.

Therefore, it is necessary to focus on these ten items in risk management. Specifically, the causes of these ten risks mainly include organizational structure, human resources, culture, evaluation indicators, evaluation system, new business evaluation, authorization approval, performance appraisal, internal audit, and information system.

In the risk assessment of loan projects, all risk elements will impact the assessment results of loan risk. Firstly, in the risk assessment, the risk level of U1 is calculated by using the fuzzy assessment method. In calculating the risk level, firstly, the evaluation matrix of a single factor is established respectively. The established risk factor set is X= {x1, x2, x3}. In the calculation, the final result is obtained through weighted balance processing according to the results scored by experts. The evaluation performance of the risk management environment is U11 = {R1, R2, R3}, which belongs to the collection within the scope of U. Rik means that the I and j conditions may lead to the attribution of risk probability to the K (k = L, 2, 3, 4, 5) level in the evaluation.

In the above evaluation matrix, «r1, 2, r3» represents the risk level, significant, medium, and small, respectively. The remainder index represents the degree of membership. Fuzzy matrix multiplication is used to calculate the weight set A and single factor evaluation matrix U, and the comprehensive evaluation set is obtained through calculation., which is as follows:

The meaning represented by (b1, b2, b3) in the above calculation formula is the membership degree of risk assessment, which means large, medium, and small, respectively.

In the risk assessment, the specific risk situation can be clarified through the assessment indicators, which can be calculated and analyzed by suitable methods such as fuzzy distribution method, maximum membership degree method, and weighted average method. During the analysis of the weighted average method, each index is centrally processed through normalization measures. After the centralized processing, the weight value of the evaluation element can be obtained, and then the weighted evaluation processing is carried out according to the calculated weight value. The main feature of the risk assessment set is non-quantitative. In the specific calculation and analysis, it is necessary to quantify the processing indicators, and then multiply the hands

and values. In the research, the possibility of risk is divided into large, large, medium, tiny, corresponding to P1 = 0.9, P2 = 0.7, P3 = 0.5, P4 = 0.3, and P5 = 0.1 respectively Fuzzy distribution method: in the analysis, the possibility of risk is divided into large, large, medium, small and minor. During calculation, the accuracy of calculation results can be improved through normalization.

Comprehensive assessment of «secondary index risk». During risk assessment, it is necessary to calculate the loss degree caused by the risk. The method used in measuring the degree of risk loss is consistent with the measurement method of risk occurrence probability. In order to ensure the accuracy and objectivity of risk assessment, it is necessary to comprehensively evaluate all risk factors of the project. The specific evaluation results are shown in Table 3.14.

Table 3.14 – Risk assessment results

Risk level	Scores	illustration
Extremely high	9-10	The risk is very high
Very high	8-9	Great risk
high	7-8	High risk
moderate	6-7	At risk
low	3-6	Low risk
Extremely low	0-3	Very little risk

Source: formed by the author

Construct the factor set. Combined with the risks mentioned above, the risk factor set of Z branch's private higher education institution loan business is expressed as: X= {x1, x2, X3}. After establishing the basis of the risk factor set, determine the total station sum of each factor. Through the above operations, the risk weight matrix as shown in table 3.15 is obtained.

Table 3.15 – Risk weight matrix W

U1	U11	U12	U13
U11	1	3	7
U12	1/3	1	4
U13	1/7	1/4	1
Sum by column	1.4763	5.5	1.2

Source: formed by the author

Based on the risk matrix W, normalize each column to obtain the judgment matrix as shown in Table 3.16.

Table 3.16 – Judgment matrix after normalization

U1	U11	U12	U13	Sum according to TF
U11	0.6774	0.7059	0.5833	1.966
U12	0.2258	0.2353	0.3333	0.7944
U13	0.0968	0.0588	0.0833	0.2389

Source: formed by the author

After normalization, the weight values of three factors can be obtained, specifically: A = {0.6556, 0.2648, 0.0796}. After the weight value is obtained, a consistency test is required. Through calculation, CI = 0.0163 and RI = 0.59, and then the consistency index can be calculated. The consistency index is CR = $\frac{C_1}{R_1}$ = 0.028 < 0.1, the calculation results show good consistency. Then we get: A = {a1, a2, a3}={0.645, 0.2677, 0.0787}. On this basis, the total evaluation data of the risk occurrence probability is calculated. The evaluation criteria are processed after the calculation is completed. First, normalize all indicators and calculate the results of risk probability summation assessment. According to the evaluation set, the risk factor set belongs to medium risk.

The evaluation matrix, weight set, and factor set of all secondary indicators in the constructed risk assessment system are calculated. Specifically, the calculation results are shown in table 3.17.

The secondary risk in the risk management environment of the Z branch mainly includes three aspects: organizational structure, management concept, and human resources. The calculated risk probability and loss value are shown in table 3.18.

By calculating the risk management environment of the Z branch, the final result is 6.675234 points, which corresponds to the risk rating standard. It is concluded that the risk belongs to general risk, indicating that the Z branch has the risk of loan chance management in the loan business of PHEI.

Table 3.17 – Risk probability expectation and loss expectation

Primary index	Secondary index	Probability	Loss expectation
Management environment U1	Organizational structure	0.686	6.276
	Human resources U13	0.184	3.361
	Management culture U14	0.295	5.153
Risk assessment U2	Evaluation index U21	0.745	5.549
	Evaluation system U22	0.542	6.676
	New business assessment	0.304	2.710
	Authorized approval U25	8.628	0.752541
U3 management activities	Performance appraisal	8.033	0.143411
	Internal audit U32	6.267	2.037303
Information and communication U4	Information system U41	5.672	0.369897

Source: formed by the author

According to the above calculation method, the risk probability and loss value of risk assessment in loan risk management of the Z branch are calculated as shown in table 3.19.

Table 3.18 - Probability and loss of risk management environment

combination	1	2	3	4	5	6	7	8	Total
U1	√	√	√	×	√	×	×	×	
U2	√	√	×	√	×	√	×	×	
U3	√	×	√	√	×	×	√	×	
Combination probability	0.039	0.17297	0.87221	0.01785	0.386805	0.07817	0.0399	0.17705	1
Combined loss value	13.3	9.939	8.628	8.033	6.267	5.672	3.361	0	/
probability X loss value	0.519	1.71916	0.75254	0.14341	2.037303	0.3699	0.1342	0	6.67523

Source: formed by the author

According to the above table, the analysis score of risk assessment in the loan risk of the Z branch is 7.289237, which belongs to high risk.

According to the results in table 16, the combined assessment of risk probability and loss of the SQ University loan project of the debtor of Z branch is 7.643215 points, which is between 7 and 8 points, which is a high risk, indicating that the threat still exists.

Table 3.19 – Probability and loss of risk assessment

combination	1	2	3	4	5	6	7	8	Total
U4	√	√	√	×	√	×	×	×	
U5	√	√	×	√	×	√	×	×	
U6	√	×	√	√	×	×	√	×	
U7	√	×	×	√	×	×	×	×	
Combination probability	0.123	0.28104	0.10373	0.04202	0.237482	0.09619	0.035	0.08286	1
Combined loss value	12.94	1.225	7.259	8.386	5.549	6.676	2.71	0	/

Source: formed by the author

According to the above table, the analysis score of risk assessment in the loan risk of the Z branch is 7.289237, which belongs to high risk.

According to the results in table 16, the combined assessment of risk probability and loss of the SQ University loan project of the debtor of Z branch is 7.643215 points, which is between 7 and 8 points, which is a high risk, indicating that the threat still exists.

Table 3.20 – Loss expectation and probability combination evaluation of risk

Combination	1	2	3	4	5	6	7	8	total
U1	√	√	√	×	√	×	×	×	
U2	√	√	×	√	×	√	×	×	
U3	√	×	√	√	×	×	√	×	
Combination probability	0.037	0.172971	0.103728	0.042016	0.237482	0.103728	0.03992	0.177051	1
Combined loss	13.3	9.939	7.259	8.386	5.549	7.259	3.361	0	/
Probability x loss value	0.532	1.719157	0.75296	0.352345	1.080306	0.75296	0.13213	0	7.643215

Source: formed by the author

The risk score of the SQ University loan project of the debtor of the Z branch is 6.73457, and the risk value is between 7 and 8, which belongs to high risk (Table 3.21).

The analysis of this study shows that the loan projects of PHEI have different risk characteristics from enterprises, namely: concealment, uncertainty, and latency, which is consistent with the theoretical hypothesis H1. Therefore, the theoretical hypothesis H1

is accepted. The income and payment of PHEI are pretty stable in a certain period, time. The total annual income of the debtor SQ university is about 190 million yuan, and its primary source of income is tuition and miscellaneous fees. From the perspective of income sources from 2016 to 2020, tuition and various fees account for 82.72%~88.56% of its total revenue. In terms of expenditure, SQ college teaching expenditure is one of the most critical expenditures, accounting for about 20%.

Table 3.21 – Loss expectation and probability combination evaluation of project management risk

Combination	1	2	3	4	5	6	7	8	Total
U4	√	√	√	×	√	×	×	×	
U5	√	√	×	√	×	√	×	×	
U6	√	×	√	√	×	×	√	×	
U6	√	×	×	√	×	×	×	×	
Combination probability	0.037	0.172971	0.103728	0.042016	0.237482	0.103728	0.03992	0.177051	1
Combined loss value	13.3	9.939	7.259	8.386	5.549	7.259	3.361	0	/
Probability x loss value	0.5325	1.819157	0.95296	0.452345	1.120306	0.75296	0.21213	0	6.73457

Source: formed by the author

Different from enterprises, college loans are not to solve the shortage of funds for production, operation, and long-term development. The obtained loan funds need to improve school running ability, teachers' level, academic work, and other aspects. Therefore, for colleges and universities, the investment benefits of loans cannot be reflected by enterprises, and there is certain concealment. This characteristic also leads to the significantly reduced predictability of commercial banks for the loan income of colleges and universities. It increases the loan risk of commercial banks to a certain extent. At present, the valuation of assets of colleges and universities in China is not precise. It is difficult to quantitatively evaluate the effect of loans provided by commercial banks on the improvement of intangible assets of colleges and universities, so there is significant uncertainty. Therefore, this makes the loan risk supplied by commercial banks for colleges and universities have great potential. The products or

services provided by colleges and universities belong to quasi-public goods. Even if there are some differences between private colleges and universities and public colleges and universities, the quasi-public goods attribute of their products still exists. On the one hand, the publicity of higher education and the autonomy of private colleges and universities make private colleges and universities need to bear the responsibility of principal and interest repayment. On the other hand, under certain circumstances, private colleges and universities can transfer the loan risk to the government through corresponding measures to disperse the threat. Li Yunda and Zhou Decai (2006) analyzed the characteristics of university project loans, mainly including a large amounts of funds, long cycles, and so on. Unlike the university project loans targeted by the Institute, this study mainly analyzes the overall loans of Chinese PHEI. The research scope is broader than the former, and the conclusions are more representative. Lei Zhenhua and Zou Guo (2014) mainly analyzed the common points of college loans and enterprise loans. This study focuses on analyzing their differences, which will be more helpful for commercial banks to manage the risk of loan projects of PHEI.

Based on the unique hidden, uncertain, and latent risk characteristics of PHEI loans, commercial banks need to formulate a loan risk management and evaluation system different from enterprises to avoid loan risks better. This is consistent with the theoretical hypothesis H2. Therefore, the speculative hypothesis H2 is accepted. Ma Fuhua (2014) took rural project loans as a case study and constructed the corresponding risk assessment system. Gaofeng (2014) conducted a comprehensive analysis and Research on the risk management of agricultural loan projects of rural credit cooperatives, and constructed the corresponding loan risk assessment system. Therefore, the current research mainly focuses on enterprise loans, while there is relatively little research on the risk management evaluation system of loans from PHEI. This study makes up for this deficiency. The risk management evaluation system constructed in this study consists of five levels: management environment, risk assessment, management activities, information and communication, and internal perspective. These five levels are taken as primary indicators, and then different detailed indicators are set under each primary hand to form a risk management system. The weight value is scored by the

expert group, geometric average, and finally, calculate the importance of different indicators, establish a judgment matrix, and finally calculate the weight values of primary and secondary indicators. In the research, Zheng Jun (2014) selected relevant indicators such as the proportion of current assets, self-owned funds, and non-self-owned funds at the end of the year, analyzed and studied the financial risk of colleges and universities, evaluated the financial risk by establishing a perfect financial risk evaluation system, and put forward the financial risk early warning system and early-warning system on this basis. Because the loan project of private colleges and universities has its specific attributes, the loan risk assessment system of commercial banks to enterprises can not be entirely suitable for PHEI.

This study further uses the method of empirical analysis to verify the risk management evaluation system constructed by the Z branch of HX Bank according to the loan characteristics of PHEI, which effectively reduces its own risk. At the same time, detailed and objective data and evaluation reports are also conducive to the creditor SQ university to reasonably plan the financing amount and financing channels, and promote the healthy and sustainable development of the University. This is consistent with the theoretical hypothesis H3. Therefore, the speculative hypothesis H3 is accepted. In the evaluation of the risk evaluation system constructed by the Z branch of HX Bank for the debtor SQ university loan project, the calculation result of the risk management environment belongs to general risk; The analysis of risk assessment belongs to high risk; The combined evaluation of risk probability and loss belongs to high risk; Finally, the total risk score is 6.7345, which belongs to high risk. Through the evaluation of the risk points of the loan project of XJ private university, the debtor of Y branch, and through comprehensive analysis, it is concluded that the total risk result of the loan project of SQ private university, the debtor of Z branch, is grade B. Chen Ping (2015) and others believe that in the financing process of colleges and universities, commercial banks must follow the principles of commercial bank loans and risk management when providing loans to colleges and universities, and improve the ability of risk prevention through close cooperation with colleges and universities according to the development characteristics of colleges and universities and the development of the local economy.

Liu Tiechui (2015) believed that enterprises should make full use of the loan evaluation opinions and results provided by banks to improve the financing channels of enterprises and reduce the loan risk through diversified financing channels. Gong Juhong and Wang Yaojun (2015) mainly studied the financing loan of Chinese colleges and universities. They put forward the strategy of "Bank University cooperation" in the financing of Chinese colleges and universities. This study found that the targeted evaluation system and objective and quantitative scoring of commercial banks help commercial banks more intuitively identify risks in the loan projects of PHEI. Commercial banks can take targeted measures to reduce or avoid loan risks according to the score of risk categories. Commercial banks can choose to take risks, avoid hazards, transfer risks, convert risks, hedge risks, compensate risks, control risks, and other measures according to the comprehensive combination of individual scores. At the same time, commercial banks can use the targeted evaluation system to provide charging consulting services such as loan evaluation and financing planning for colleges and universities. PHEI can also use detailed and targeted evaluation results for development planning.

3.3. Innovations in the management of human resources in universities: building a system of indices for evaluating scientific research activity based on the Delphi method

With the acceleration of economic globalization, the international competition is increasingly reflected in the competition of scientific and technological strength, and scientific and technological innovation has become the focus of attention of all countries. Innovation is the manifestation of scientific research activities, and the scientific research activities of colleges and universities provide scientific and technological support for the reform of various industries. The accumulation of the achievements of scientific research projects in colleges and universities finally forms the output of innovative achievements, and the performance evaluation of teachers in colleges and universities is an important means to guarantee the output of scientific research projects. At present, the project performance evaluation of university teachers is still dominated

by peer review, which is mainly isolated evaluation based on the project content and lacks a set of effective index system as guidance, which makes the performance evaluation of university teachers inevitably affected by subjective factors to a certain extent. Therefore, how to construct a set of operable index system is an urgent problem to be solved in the current performance evaluation of college teachers. Based on the review of relevant literature, this paper analyzes the principles of scientific research project performance evaluation, and uses Delphi method and analytic hierarchy process to explore the construction of performance evaluation index system for different types of university teachers, in order to provide enlightenment for the practice of university teachers' performance evaluation.

Search the official websites of the Ministry of Human Resources and Social Security of China and the Department of Human Resources and Social Security of Henan Province from 2014 to 2020, consult relevant policies, regulations, research reports and other materials on performance evaluation, and understand the current requirements on performance evaluation of university teachers from the policy level. The databases including PubMed, CNKI, Wanfang, and VIP were searched from January 2014 to December 2020.Using «university teachers» and «performance» and «evaluation index», «teacher» and «Scientific research» and «evaluation», «university» or «performance» and «Scientific research evaluation» as the search terms, subject word retrieval and free word retrieval were carried out. Literature screening and data extraction: read the title and abstract, exclude the less relevant literature, and further read the full text to extract effective information. The contents include: basic information of literature publication, management of scientific research in universities, elements of evaluation index, weight distribution, advantages and disadvantages, current situation of scientific research of teachers in universities and so on. The members of the research group collected, sorted out, analyzed and summarized the effective information, which laid a solid data foundation for this study.

Comb through expert interviews, panel meeting key factors, using the decomposition of the elements of the target step by step, considering the importance of the evaluation index, practicability, maneuverability, combined with the basic conditions

and the connotation of hospital pharmacy personnel requirements, the preliminary set up index system of the item pool, form the first round of the questionnaire.

A total of 32 persons are selected from the personnel departments of the Chinese government and the persons in charge of scientific research management and human resources management of undergraduate universities and associate professors with a master's degree or above (Table 3.22).

Table 3.22 – Compositions of experts for Delphi methods

Item	Classification	Number of people	Constituent ratio（%)
Sex	Male	18	56.25
	Female	14	43.75
Degree	Master	10	31.25
	Doctor	22	68.75
Academic title	Associate professor	15	46.88
	Professor	17	53.12
Years of working	10~15 years	12	37.5
	More than 15 years	20	62.5

Source: formed by the author

An expert advisory group was formed to conduct two rounds of questionnaire survey, and the expert opinions of each round were sorted out and analyzed. After two rounds of information feedback, the scattered opinions were gradually concentrated, and the framework of the performance evaluation system for university teachers was determined.

Analytic Hierarchy Process (AHP) Establishment of Hierarchy Structure Model According to the framework of the evaluation system, the hierarchy structure model is established, with the first-level index as the target layer and the second-level index as the indicator layer. A judgment matrix was constructed to design the third round of survey table, and experts were invited to compare the importance of each element at the same level in pairs. The comparative judgment is quantified and the judgment matrix is constructed. The relative weight calculation and consistency test of hierarchical single sorting. When the relative weight of each level factor is determined, then according to

the correlation of each level, the weight calculation and consistency test of the total ranking combination of the level are carried out.

Statistical Methods SPSS 20.0 software was used to input data, calculate Kendall harmony coefficient and conduct statistical test to determine the degree of coordination of expert opinions. SPSS 20.0 software was used to input data, and the comprehensive evaluation of the application evaluation index system was carried out.

Because the performance evaluation system of university teachers is a complex, comprehensive, multi-level comprehensive index system, so in the index Delphi method and analytic hierarchy process are used to construct a scientific and effective performance evaluation system for teachers in colleges and universities, so as to guide the performance evaluation of colleges and universities.

Questionnaire design. The questionnaire of scientific research project performance evaluation system is mainly designed based on literature review and field research. Literature review is an important basis for questionnaire design. Many scholars have carried out abundant research on the performance evaluation system of colleges and universities from different points of view. The index evaluation system applied to colleges and universities is designed. Reading, combing and summarizing a large number of literature and fully drawing on previous research experience can provide ideas and guidance for the design of this questionnaire. Field research is an important supplement to the questionnaire design. Through field research and interviews with the scientific research project management department and the research team, we can have a deeper understanding of the actual situation and needs of the performance evaluation of scientific research projects, and supplement and improve the questionnaire. Through interviews, teachers in colleges and universities were asked for their opinions and suggestions on the design of performance evaluation indicators in the questionnaire. On the basis of literature review and field research, the questionnaire for expert consultation was determined, and three options were set for each question: «appropriate», «inappropriate» and «suitable after modification».

In this paper, the Delphi method is used for expert consultation. Delphi method is also called expert survey method, its procedure is the research group through the network

communication. The problems to be solved are sent to experts, who make independent judgments on the investigated problems in the form of anonymity and fully express their opinions. After repeated questioning and modification of the questionnaire through several rounds of expert surveys, gradually convergent expert opinions are finally obtained. Usually panelists generally 15 to 50, considering this subject mainly study of scientific research project, the team finally chose to 32 experts from government personnel management departments, universities, the preliminary design of the questionnaire in the form of an email sent to each expert, through three rounds of feedback and revision, experts made a relatively consistent opinion, evaluation indexes for basic identified the university teachers' performance. Evaluation index system, a total of 6 first-level indicators, 20 second-level indicators.

The weight of college teachers' performance appraisal index is determined by Delphi method and analytic hierarchy process. The main steps are as follows.

Constructing the hierarchical structure of the target level, middle level and bottom level of the performance appraisal index system of university teachers.

Establish the judgment matrix. After establishing the hierarchical structure model of the performance appraisal index of college teachers, the judgment matrix of the downward index to the upper index is determined. In the third round of consultation, experts conducted pair comparison on the weight of each index of the evaluation system, and pair comparison scale was carried out with the scaling method of 1-9 to obtain the consensus judgment matrix A-B.

$$A=\begin{bmatrix} a11 & a12 & \cdots & a1n \\ a21 & a22 & \cdots & a2n \\ \cdots & \cdots & \cdots & \cdots \\ an1 & an2 & \cdots & ann \end{bmatrix} \tag{3.1}$$

Where aij is the value of the comparison between the two importance of item and factor j. When i= j, aij = 1 means that factors are as important as themselves. aij= 1 / aij, the same principle can be used to get other judgment matrices.

For judgment matrix A, sum product method is used to calculate the weight of each factor. The comparison matrix A can be obtained by two comparison method, and the consistency index test is needed. The consistency ratio (CR) is the ratio of the consistency index and the random consistency index R.I. When Cr is less than 0.10, it is considered that judgment matrix A has satisfactory consistency.

According to the unified opinions of experts and the analytic hierarchy process, the weights of the first-level and second-level indicators for the performance evaluation of college teachers are determined, as shown in Table 3.23.

By summing up all the second-level indicators subordinated to each first-level indicator, the index weight ratio of the six first-level indicators, namely basic quality, teaching technology, academic technology and scientific research achievements, social service and honor award, can be obtained. Among them, the weights of first-level indicators of teaching-oriented teachers are 0.12, 0.46, 0.15, 0.11, 0.02, 0.14;The weights of first-level indexes of scientific teachers were 0.12, 0.09, 0.17, 0.37, 0.06, 0.19;The first-level index weights of application-development teachers were 0.12, 0.11, 0.19, 0.05, 0.48 and 0.05.In conclusion, we can draw teaching subject in colleges and universities teachers' work performance evaluation index system, weight first of educational technology, the second and the third scientific research achievements, academic technology teaching technology the highest weight, two, three were similar, instructions for teachers in teaching oriented college, from processing to do a good job of teaching at the same time, also should balance degree, the title promotion, continuously updated professional knowledge, but also should pay attention to complete the corresponding research. Scientific research is a fine college teachers performance evaluation index system of the most important part of academic technology and social service separated two, three, focus on scientific research and discipline construction, etc., to take to the high-level personnel training, innovation team and talent of tilt and key talents, achievements and contribution, to encourage outstanding teachers in scientific research, disciplines the breakthrough.

Table 3.23 – Performance evaluation index system of college teachers

The evaluation index		The teacher type					
		The teaching model		Scientific research type		Application development type	
Level indicators	The secondary indicators	First level index weight	Second-level index weight	First level index weight	Second-level index weight	First level index weight	Second-level index weight
Basic quality B1	Comprehensive ability C11	0.12	0.4	0.12	0.4	0.12	0.4
	Information literacy C12		0.3		0.3		0.3
	The scientific spirit C13		0.3		0.3		0.3
Educational technology B2	The teaching effect C21	0.46	0.39	0.09	0.39	0.11	0.39
	Teaching workload C22		0.23		0.19		0.20
	Teaching and research C23		0.21		0.20		0.21
	To guide the students C24		0.17		0.22		0.20
Academic technology B3	Society Journals C31	0.15	0.07	0.17	0.11	0.19	0.09
	The title is C32		0.22		0.24		0.27
	Degree in a C33		0.36		0.41		0.23
	The knowledge structure C34		0.35		0.24		0.41
Scientific research achievements B4	Subject project C41	0.14	0.29	0.37	0.25	0.05	0.24
	Subject to completeC42		0.23		0.25		0.24
	The paper C43		0.21		0.27		0.25
	Academic work C44		0.27		0.23		0.27
Social services B5	Patent C51	0.02	0.35	0.16	0.24	0.48	0.18
	The new technology C52		0.25		0.25		0.27
	Achievements transformationC53		0.40		0.51		0.55
Honor rewards B6	Teaching awards C61	0.11	0.81	0.09	0.17	0.05	0.11
	Scientific research awards C62		0.19		0.83		0.89

Source: formed by the author

Applied university teachers of social service is the performance evaluation index system of the most important part of academic technology, basic quality separated two, three, proportion of teaching and scientific research work, compared with other two kinds of teachers, therefore, can be summed up in the application development of university teachers is given priority to with social services, basic quality, academic technology is complementary, should pay attention to the improvement of social approval. At the same time, through a survey of the weights of the three first-level indexes, it can be found that the weight of basic quality is 0.12, which accounts for the same proportion but is not high. Therefore, it indicates that basic quality is also a relatively basic index for the evaluation of college teachers and plays a supporting role for other indexes. Therefore, teachers of the three types of colleges and universities should pay attention to it.

University selection and evaluation object selection. According to the types of colleges and universities, this paper selects applied colleges and universities that undertake the main undergraduate teaching under the background of higher education popularization. As application-oriented universities undertake less postgraduate education, their teacher classification evaluation is relatively simple and easy to operate. In the existing teacher evaluation system, both year-end evaluation and promotion of professional title take scientific research as the primary factor, so scientific research and teaching scientific research teachers like a duck to water. However, in the existing evaluation system, the achievements of teaching-oriented and application-oriented teachers are often not recognized and cannot get due rewards. Therefore, this study selects the teaching-oriented and application-oriented teachers who are at a disadvantage in the traditional evaluation system as the main object of the case study, and adds teachers with strong scientific research ability as a reference.

Taking an application-oriented undergraduate college in Henan Province of China as an example, the teacher classification has changed from one management mode to classified management, and the teacher position is divided into teaching type, scientific research type and application development type, and different evaluation index system

and career development path are designed. We have selected 3 typical teachers as cases, and their data are as follows：

Teaching-oriented teacher A:A, born in 1980, graduated from A famous University in China as A master student in 2007, and worked as A professional course teacher in an undergraduate college. He was employed as A lecturer in 2009. A takes an active part in the construction of disciplines, majors and laboratories of the School, and is extremely devoted to teaching. Although there is little change in specialized courses, he insists on preparing lessons for each class. He is particularly good at bringing events in life into class, telling them to students as cases, and publishing academic papers on his teaching experience. She often answers students' questions in her spare time. She has set up a wechat group for underachiever students to ask questions at any time. He is strict with his students, but he is loved by his students. He has been named «the most beautiful Teacher» for many times and won the first prize in the school's lecture competition in 2018. Although teacher A invested a lot of energy in teaching, but also made some achievements, but because of the lack of high-quality longitudinal subjects, the quality of scientific research papers is not high, so the year-end assessment is very difficult to excellent, the title has been a lecturer. Compared with peers, some teachers are already professors.

Scientific research teacher B:B, male, born in 1985. After graduation from a Chinese university in 2012, HE entered an undergraduate college to teach food courses as a professional course teacher and was employed as a lecturer in 2016. B has strong scientific research ability and is the backbone of the laboratory construction of the college. During the teaching period, he published 5 academic papers in SCI journals. In terms of teaching, B takes up a lot of energy by experiments and thesis writing, and only completes the minimum teaching workload with average teaching effect. B's scientific research achievements A number of scientific research achievements have cooperated with food enterprises and been widely applied in the province. 2 provincial projects have won the provincial first prize and 1 provincial project has won the provincial second prize. Due to high-level vertical scientific research projects and high-level academic papers since the entry of B, the year-end assessment has been excellent.

Application-oriented teacher C:C, male, born in 1976, graduated from a university in China in 2003 and then entered an undergraduate college to teach courses in the field of computer as a professional course teacher. He was employed as a lecturer in 2003. With strong hands-on ability, C is the backbone of the laboratory construction of the college and also participates in the construction of disciplines and majors. His application development level is well-known in the school, and he is invited to develop the software of some functional departments in the school, which has a good running effect. Ding is also good at transferring small products developed by himself to the classroom as cases and incorporating them into his teaching content, which has been well received by students. Ding has good communication skills and often cooperates with enterprises to develop software systems. In recent years, the annual horizontal funds received are about 700,000 yuan, and he has also obtained 5 software Copyrights and 3 national invention patents. Although Mr. Ding has obtained some horizontal projects and invention patents, he has lacked high-level vertical scientific research projects and high-level academic papers in recent years, so it is difficult to get an excellent year-end assessment. At present, he is only a lecturer. According to the materials of the above two teachers, the department assessment Committee will evaluate their performance in 2020 according to the new assessment system.

The evaluation scores and results are shown in Table 3.24.

Delphi method has the characteristics of anonymity, information feedback and statistical analysis of results, which can effectively avoid the tendency of agreeing with and blindly following authority that may appear in the consultation of expert meeting. The shortcoming lies in that experts' understanding of indicators is inevitably restricted by subjectivity, so the selection of experts is a crucial link, which is directly related to the quality of research. In this study, the influence factor was fully considered in the selection of experts. The results of expert enthusiasm, expert authority coefficient and Kendall harmony coefficient show that the reliability is ideal. Analytic Hierarchy Process (AHP) is a semi-quantitative decision-making analysis method proposed by Saaty, an American operations researcher, in the 1970s. It is a method to model and quantify the decision-making thinking process of decision-makers in complex systems.

Table 3.24 - The evaluation scores and results

The evaluation index		Evaluation of teachers'											
		Teaching teacher A				Research teacher B				Application development teacher C			
Level indicators	The secondary indicators	W2	B score	W2i	C score	W2	B score	W2i	C score	W2	B score	W2i	C score
Basic quality B1	Comprehensive ability C11	0.12	98.3	0.4	98	0.12	98.5	0.4	97	0.12	97	0.4	97
	Information literacy C12			0.3	100			0.3	100			0.3	96
	The scientific spirit C13			0.3	97			0.3	99			0.3	98
Educational technology B2	The teaching effect C21	0.45	97.66	0.39	98	0.09	55.8	0.39	60	0.11	85.29	0.39	96
	Teaching workload C22			0.23	100			0.19	60			0.20	50
	Teaching and research C23			0.21	95			0.20	50			0.21	85
	To guide the students C24			0.17	97			0.22	50			0.20	100
Academic technology B3	Society Journals C31	0.15	84.3	0.07	0	0.17	88.66	0.11	80	0.19	81.66	0.09	0
	The title is C32			0.22	80			0.24	80			0.27	80
	Degree in a C33			0.36	90			0.41	90			0.23	90
	The knowledge structure C34			0.35	98			0.24	99			0.41	96
Scientific research achievements B4	Subject project C41	0.11	54.3	0.29	50	0.37	98.29	0.25	95	0.05	38.4	0.24	60
	Subject to completeC42			0.23	100			0.27	100			0.24	100
	The paper C43			0.21	80			0.27	100			0.25	0
	Academic work C44			0.27	0			0.23	98			0.27	0
Social services B5	Patent C51	0.02	0	0.35	0	0.06	57.6	0.24	50	0.48	98.65	0.18	100
	The new technology C52			0.25	0			0.25	60			0.27	95
	Achievements transformation C53			0.40	0			0.51	60			0.55	100
Honor rewards B6	Teaching awards C61	0.15	88.88	0.81	98	0.19	91.5	0.17	50	0.05	50	0.11	50
	Scientific research awards C62			0.19	50			0.83	100			0.89	50
The evaluation results		86.74				85.73				88.31			

Source: formed by the author

The basic principle is to decompose the various elements of the alternative scheme of the evaluation system into several levels, and take the various elements of the same

level as the criteria of the elements of the upper level to judge and compare pairwise and calculate the weight of each element.

From the above research, we can draw the following conclusions.

1. Traditional college teacher performance assessment methods are relatively single, the assessment index system is difficult to quantify, operability is poor, static assessment is mainly, the lack of dynamic grasp of the whole process of work and other deficiencies. According to the variability and complexity of the work content of university teachers, the performance evaluation system based on the classified development of university teachers can make the performance evaluation index system of university have a scientific standard and a relatively objective evaluation standard.

2. In the classified evaluation of colleges and universities, the evaluation indicators and weights can be adjusted flexibly according to the actual situation of the school and the actual work of different types of teachers (including research teachers, teaching teachers, application and development teachers, etc.), so as to achieve a comprehensive and accurate evaluation of the performance of various teachers and promote the sustainable development of colleges and universities and teachers.3.The performance evaluation system based on the classified development of college teachers can realize the realization of «giving full play to talents» and fully stimulate the enthusiasm of different types of teachers. The personnel department of the school can set up relevant institutions to help teachers rationally understand themselves and position themselves, so that teachers can correctly understand their strengths and weaknesses; At the same time, combining with the development strategy and goals of the school, teachers can reasonably determine their own career positioning and development goals, so as to achieve the coordinated development of the school and individuals.

The shortcomings of this study are that there are many items in the evaluation index system constructed, the scoring is complicated, and the assignment of individual indexes is not reasonable, which affects the weight coefficient and the comprehensive scoring results to a certain extent. This evaluation system needs to be verified by more examples, and further optimized and improved, in order to reflect the real situation of

the evaluated more comprehensively and objectively, and provide data support for the construction of university teachers' talent echelon and discipline development.

Conclusion to the Chapter 3

1. Artificial intelligence includes 13 subfields. In April 2019, a total of 35 universities across the country obtained the first batch of artificial intelligence professional construction qualifications. Closely related to the development of the artificial intelligence industry, 101 colleges and universities added robot engineering majors, 96 colleges and universities added intelligent technology majors, and 50 colleges and universities added intelligent manufacturing engineering majors. AI curriculum system is based on computer science and technology. The demand for AI professionals is growing rapidly. The number of existing enrollment institutions has stabilized, and some colleges and universities have increased slightly. In 2019, more than 30 universities in China set up artificial intelligence colleges or research institutes, and 75 universities independently set up 89 second-level disciplines or interdisciplinary disciplines related to artificial intelligence. As of June 2019, a total of 28 universities have set up artificial intelligence schools or related schools. Some universities only set up artificial intelligence research institutes. According to the advantages, characteristics and establishment of the artificial intelligence Academy, the source of teachers is also different. There are three main types of teachers :(1) teachers transferred from existing universities; (2) Integrate AI-related teachers from different institutions; (3) Some universities and enterprises jointly establish artificial intelligence colleges, and set up teachers through cooperation with enterprises. The lack of professional level disciplines in AI limits its development, and there is a lack of systematic curriculum.

2.On the one hand, we should pay attention to the basic theoretical research of artificial intelligence, and on the other hand, we should pay attention to the key core technology innovation of artificial intelligence. College of Artificial Intelligence should focus on scientific and technological innovation in the field of artificial intelligence, starting from the following aspects: First, strengthen the research on basic theories of artificial intelligence, focus on major scientific frontier issues of artificial intelligence,

and focus on the research of AI-related theories, methods, tools and systems to provide theoretical support for the transformation of artificial intelligence paradigm. Third, we should not only focus on key areas of artificial intelligence innovation, but also focus on first-class talents and high-level think tanks in key areas of artificial intelligence innovation, strengthen international academic exchanges and cooperation, and promote the development of artificial intelligence. The College of Artificial Intelligence not only undertakes the task of personnel training and scientific research in this field, but also promotes the integration of artificial intelligence and economic and social development. According to the composition of the School of Artificial Intelligence, the school attaches great importance to cooperation with relevant enterprises and local governments, focusing on the transfer of artificial intelligence technology and the transformation of results. As artificial intelligence is a high and new technology with a wide range of influence, with the rapid development of the new generation of artificial intelligence, it will gradually have a profound impact on many fields of society. Therefore, college of Artificial intelligence should focus on strengthening the research of artificial intelligence serving society, and promote the integration and development of artificial intelligence and related fields of society.

3.The analysis of this study shows that the loan projects of PHEI have different risk characteristics from enterprises, namely: concealment, uncertainty, and latency. Based on the unique hidden, uncertain, and latent risk characteristics of PHEI loans, commercial banks need to formulate a loan risk management and evaluation system different from enterprises to avoid loan risks better. The targeted evaluation system and objective and quantitative scoring of commercial banks help commercial banks more intuitively identify risks in the loan projects of PHEI. Commercial banks can take targeted measures to reduce or avoid loan risks according to the score of risk categories. Commercial banks can choose to take risks, avoid hazards, transfer risks, convert risks, hedge risks, compensate risks, control risks, and other measures according to the comprehensive combination of individual scores. At the same time, commercial banks can use the targeted evaluation system to provide charging consulting services such as

loan evaluation and financing planning for colleges and universities. PHEI can also use detailed and targeted evaluation results for development planning.

4. Traditional college teacher performance assessment methods are relatively single, the assessment index system is difficult to quantify, operability is poor, static assessment is mainly, the lack of dynamic grasp of the whole process of work and other deficiencies. According to the variability and complexity of the work content of university teachers, the performance evaluation system based on the classified development of university teachers can make the performance evaluation index system of university have a scientific standard and a relatively objective evaluation standard. In the classified evaluation of colleges and universities, the evaluation indicators and weights can be adjusted flexibly according to the actual situation of the school and the actual work of different types of teachers (including research teachers, teaching teachers, application and development teachers, etc.), so as to achieve a comprehensive and accurate evaluation of the performance of various teachers and promote the sustainable development of colleges and universities and teachers.

5.The performance evaluation system based on the classified development of college teachers can realize the realization of "giving full play to talents" and fully stimulate the enthusiasm of different types of teachers. The personnel department of the school can set up relevant institutions to help teachers rationally understand themselves and position themselves, so that teachers can correctly understand their strengths and weaknesses; at the same time, combining with the development strategy and goals of the school, teachers can reasonably determine their own career positioning and development goals, so as to achieve the coordinated development of the school and individuals.

CONCLUSION

The dissertation substantiates the theoretical and methodological principles and develops practical proposals for the management of innovative processes of a higher educational institution and comprehensively explains and emphasizes the necessity of the innovative nature of the management system of higher education institutions. The most important results of the study are the following.

1. The research on the reform of internal management system in colleges and universities in China mainly follows several ideas. The first is the study on the deficiency, which mainly analyzes the conditions and preparations needed for deepening the reform of internal management system, especially the preparation for thinking and social environment. The analysis of the meaning function, necessity and urgency of the reform of the internal management system of colleges and universities occupies a considerable proportion in the so-called research on the deficiency. The second is the research on the target system of the reform of the internal management system in Chinese universities. Establishing a democratic school running system that relies on the democratic participation, democratic decision-making, democratic management and democratic supervision of the staff; construction of high-quality teachers and management team, improve the employment, assessment and reward and punishment system, improve the overall quality of the staff.

2. Four main theories of management were studied. Their advantages and disadvantages are determined, which consider the specifics of the activities of educational institutions in China. Hierarchy theory emphasizes differences in the division of labor at different levels of management of educational institutions. The size of the institution, the distribution of subjects and disciplines, the formation of an organizational system with effective control and coordination at lower levels should be considered when creating an innovative management system. The theory of human capital is of great importance in the context of discussing the function of educational institutions and directions for introducing innovations into the management system. Understanding social value is an important basis for determining the function of higher

education institutions. Full awareness of the differences between the needs of human capital and the dynamism of the development of economic systems determine the scale of professional development of educational institutions and the entire society. According to the theory of competitiveness, the management of educational institutions cannot copy a set of innovative management methods at enterprises in the real sector of the economy. The introduction of innovations in the management system of educational institutions should focus on teaching, scientific research and improving the quality of education.

3. With the «Belt and Road» policy, Shanxi and Chongqing have gained considerable growth in higher education, and the quality level has been rapidly improved. Class II «medium efficiency» provinces and three areas have both. It is noteworthy that Beijing, as the center of China's politics, economy and culture, also belongs to class II «medium efficiency», which indicates that Beijing is insufficient in the allocation and utilization of GFHE resources, showing problems such as excessive input of resources and low input-output efficiency. Moreover, as economically strong provinces, Zhejiang Province and Guangdong Province also offer a low level of GFHE performance. The reason for its low efficiency is that the expansion speed of the GFHE fund scale does not keep a good fit with the improvement of quality. Class I «low efficiency» is mainly concentrated in the western area. The main reasons for its low efficiency are an underdeveloped economy, common scale of GFHE, and imperfect development of the higher education system. At the same time, the provinces whose SE has not reached the optimal scale have the problems of mismatch and too much or too little funding in the configuration and development needs of GFHE.

4. In eastern China, the per capita GDP (coefficient = 0.4942, $P < 0.1$) and the degree of urbanization (coefficient = 0.4721, $P < 0.05$) are the favorable factors affecting the performance of GFHE, while the student-teacher ratio of higher education institutions (coefficient = -0.0738, $P < 0.1$) is the unfavorable factor. The proportion of employees with a college education or above, the proportion of government financial expenditure in regional GDP. The proportion of tertiary industry output value in GDP in each province has no significant impact on in Central China. In central China, the degree of urbanization (coefficient = 0.2551, $P < 0.05$) is the favorable factor affecting the

performance of GFHE, while the ratio of students to teachers in higher education institutions (coefficient = -0.3346, $P < 0.1$) and the proportion of tertiary industry output value in GDP of each province (coefficient = -0.3762, $P < 0.01$) are the unfavorable factors The ratio of employees with a college education or above and the proportion of government expenditure in regional GDP have no significant impact. Western China. In western China, the proportion of employed persons with a college education or above (coefficient = -0.1185, $P < 0.05$), the balance of government expenditure in regional GDP (coefficient = -0.3017, $P < 0.1$), and the ratio of tertiary industry output value in GDP of each province (coefficient = -0.1590, $P < 0.1$) are the unfavorable factors, and the per capita GDP The degree of urbanization and the ratio of students to teachers in higher education institutions have no significant impact on it.

5. Application of Input-output Performance Evaluation Method in Discipline Construction. Envelopment analysis method and matrix analysis method, it can be seen that although the analysis results are different, they are generally consistent. Combining the two analysis methods, we can make an in-depth study on the discipline construction performance of each discipline group and draw a more scientific conclusion. G4 and G11 have high input and high output. After envelope analysis, they have achieved scale efficiency and technology efficiency. Therefore, the discipline construction performance of these two discipline groups is the best, and they are in the first echelon of the University. G7, G13, G18 and G19 have high input and output. After envelope analysis, they have also achieved scale effectiveness and technology effectiveness, and are in the second echelon of the University. The discipline construction of the seven discipline groups G20, G1, G2, G8, G9, G10 and G17 has low input and output. Through envelope analysis, it has also achieved effective scale and technology, and is in the third echelon of the University. G5 discipline construction has low investment and low output. It has achieved effective technology and not effective scale, but the scale income is increasing, which is in the fourth echelon. G14, G15 and G16 disciplines have high input and output, fail to achieve effective scale, and the return on scale is decreasing, so they are in the fifth echelon. The input and output of G3 discipline construction are low, the scale is not effective, and the return on scale is decreasing, which is in the sixth echelon. G12

discipline construction has high input and low output, does not achieve effective scale, and the scale effect decreases, and is in the seventh echelon.

6. The university library has realized that the number of users of media technology (microblogs and WeChat) in the dynamic elements is large, and the installation and maintenance costs are low. It is a better platform for the marketing and promotion of knowledge services. The rich resource reserve and service content in the dynamic elements can improve user loyalty and satisfaction, and then increase the degree of communication. A good user experience in dynamic elements can increase user comfort and loyalty. It is found that only 4 of the 42 university libraries produce microfilms, and only 3 of them upload to the commercial broadcasting platform. However, its influence and scope cannot be ignored. In the more mature website service than «micro media» university libraries have established a relatively perfect knowledge service marketing system.

7. Artificial intelligence includes 13 subfields. In April 2019, a total of 35 universities across the country obtained the first batch of artificial intelligence professional construction qualifications. Closely related to the development of the artificial intelligence industry, 101 colleges and universities added robot engineering majors, 96 colleges and universities added intelligent technology majors, and 50 colleges and universities added intelligent manufacturing engineering majors. AI curriculum system is based on computer science and technology. The demand for AI professionals is growing rapidly. The number of existing enrollment institutions has stabilized, and some colleges and universities have increased slightly. In 2019, more than 30 universities in China set up artificial intelligence colleges or research institutes, and 75 universities independently set up 89 second-level disciplines or interdisciplinary disciplines related to artificial intelligence. As of June 2019, a total of 28 universities have set up artificial intelligence schools or related schools. Some universities only set up artificial intelligence research institutes. According to the advantages, characteristics and establishment of the artificial intelligence Academy, the source of teachers is also different. There are three main types of teachers :(1) teachers transferred from existing universities; (2) Integrate AI-related teachers from different institutions; (3) Some

universities and enterprises jointly establish artificial intelligence colleges, and set up teachers through cooperation with enterprises. The lack of professional level disciplines in AI limits its development, and there is a lack of systematic curriculum.

8. It is emphasized that China must strongly support the development of private educational institutions, attract all possible resources to invest in the education industry, and constantly improve the quality of teaching in educational institutions, which will contribute to the economic growth of the territories in the future. Unlike enterprises, loans to educational institutions are not solved the problem of shortage of funds for production, operation and long-term development. The received loan funds are used to improve the work of educational institutions and the quality of teaching. It has been proven that credit projects in educational institutions have differences in the identification of potential risks compared to lending in the real sector of the economy. It is noted that the services provided by educational institutions belong to quasi-public goods. Even if there are some differences between private and public colleges and universities, the quasi-public good attribute of their services still exists.

9. The analysis of this study shows that the loan projects of PHEI have different risk characteristics from enterprises, namely: concealment, uncertainty, and latency. Based on the unique hidden, uncertain, and latent risk characteristics of PHEI loans, commercial banks need to formulate a loan risk management and evaluation system different from enterprises to avoid loan risks better. The targeted evaluation system and objective and quantitative scoring of commercial banks help commercial banks more intuitively identify risks in the loan projects of PHEI. Commercial banks can take targeted measures to reduce or avoid loan risks according to the score of risk categories. Commercial banks can choose to take risks, avoid hazards, transfer risks, convert risks, hedge risks, compensate risks, control risks, and other measures according to the comprehensive combination of individual scores. At the same time, commercial banks can use the targeted evaluation system to provide charging consulting services such as loan evaluation and financing planning for colleges and universities. PHEI can also use detailed and targeted evaluation results for development planning.

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APPENDIX A

Table A.1 – Output of discipline construction of each discipline group

Name of discipline group	Output indicators										
	personnel training										
	Talent training scale			Talent training quality							
	Number of Undergraduates	Number of Masters	Number of doctoral students	Provincial Teaching Achievement Award	National Excellent Doctoral Thesis	Provincial Excellent Doctoral Thesis	Provincial excellent master's thesis	Provincial Excellent bachelor's thesis	National Quality Courses	Provincial Quality Courses	National excellent textbook
G1	1854	1375	0	2	0	0	13	98	0	2	0
G2	1158	161	7	1	0	0	0	8	0	0	0
G3	1032	620	9	1	0	0	2	64	0	1	0
G4	2144	654	38	12	0	0	9	116	1	12	4
G5	1458	786	82	0	0	0	7	102	0	3	0
G6	1288	710	38	2	0	0	2	44	1	4	1
G7	790	438	0	1	0	0	0	43	1	2	0
G8	1873	496	72	1	1	8	6	66	0	1	0
G9	711	275	0	0	0	0	2	37	1	2	0
G10	822	147	0	1	0	0	2	36	0	1	0
G11	3187	2061	456	6	3	18	34	297	2	4	3
G12	2230	886	103	2	1	4	6	74	1	2	0
G13	2496	2677	355	1	0	8	11	93	0	3	1
G14	2806	1205	134	2	0	1	7	125	1	8	1
G15	1956	455	95	3	0	3	6	86	1	2	0
G16	1858	1375	163	0	0	4	20	116	0	2	0
G17	1843	690	50	0	0	0	4	72	0	2	1
G18	1571	646	71	1	0	0	5	55	1	2	1
G19	2769	1678	97	3	0	2	6	136	2	3	0
G20	1814	1673	58	1	0	0	9	84	0	1	0

Source: formed by the author

Table A.2 – Output of discipline construction of each discipline group

Name of discipline group	Output indicators									
	scientific research									
	research project		Scientific research funds (RMB 10000)			Scientific research achievements			Scientific research base	
	National level project	Provincial topics	Total scientific research funds	Horizontal scientific research funds	Vertical scientific research funds	National Scientific Research Award	Provincial Scientific Research Award	Invention patent	National scientific research base	Provincial scientific research base
G1	7	3	6818.3	5916.5	902.7	0	4	6	0	0
G2	5	3	11530.1	10210.8	1322.3	0	4	0	0	0
G3	3	0	1287.8	956.2	331.1	0	0	0	0	0
G4	37	30	6468.5	4506.7	1963.7	0	30	16	0	0
G5	12	3	1971.1	1170.5	802.7	0	4	0	0	0
G6	2	0	3427.1	2671.0	758.1	0	0	0	0	0
G7	1	0	1334.4	81.9	52.5	0	0	0	0	0
G8	4	2	7353.3	5172.4	2182.4	0	3	9	0	2
G9	2	0	641.0	320.3	321.3	0	0	0	0	0
G10	12	9	2755.2	2201.6	554.6	0	9	37	0	1
G11	104	69	28403.5	16543.6	11855.9	3	65	201	2	8
G12	20	14	19829.3	13176.3	6651.9	0	15	7	0	2
G13	41	25	9337.4	7130.5	2007.1	0	24	0	0	2
G14	20	12	13231.4	9762.1	3467.8	1	12	30	0	0
G15	21	15	11120.2	6925.0	4194.7	0	14	2	0	1
G16	19	13	14705.4	11639.7	3071.0	0	14	3	0	1
G17	10	1	8447.6	8448.9	982.2	0	1	32	0	0
G18	30	13	8564.5	8564.1	3042.6	2	11	26	0	1
G19	15	8	6073.4	6073.9	2764.0	0	8	17	0	1
G20	18	16	5770.7	5770.1	849.2	0	16	1	0	0

Source: formed by the author

TableA.3 – Weight of discipline construction investment indicators

Primary index	fixed assets		human resources				Capital investment		
Secondary index	Area of teaching and scientific research site	Instruments and equipment	Number of people with senior professional titles	Number of people with vice senior titles	Number of people with intermediate professional titles	Number of junior professional titles	National special fund	Local special funds	School self raised funds
Weight value	0.4771	0.5229	0.3612	0.1828	0.2092	0.2468	0.4675	0.5229	0.4771

Source: formed by the author

Table A.4 – Output of discipline construction of each discipline group

Primary index	Talent training scale			Talent training quality							
Secondary index	Number of Undergraduates	Number of Masters	Number of doctoral students	Provincial Teaching Achievement Award	National Excellent Doctoral Thesis	Provincial Excellent Doctoral Thesis	Provincial excellent master's thesis	Provincial Excellent bachelor's thesis	National Quality Courses	Provincial Quality Courses	National excellent textbook
Weight value	0.3674	0.3209	0.3117	0.1166	0.1162	0.1216	0.1025	0.0763	0.1982	0.1373	0.1314

Source: formed by the author

Table A.5 – Output of discipline construction of each discipline group

Primary index	research project		Scientific research funds			Scientific research achievements			Scientific research base	
Secondary index	National level project	Provincial topics	Total scientific research funds	Horizontal scientific research funds	Vertical scientific research funds	National Scientific Research Award	Provincial Scientific Research Award	Invention patent	National scientific research base	Provincial scientific research base
Weight value	0.4928	0.5072	0.1722	0.4054	0.4225	0.3932	0.3676	0.2392	0.4916	0.5084

Source: formed by the author

APPENDIX B

Table B.1 – Calculation results of C^2R model

Relaxation variable	θ^0	$S1^-$	$S2^-$	$S3^-$	$S1^+$	$S2^+$	$S3^+$	$S4^+$	$S5^+$	$S6^+$	Effectiveness results
G1	1	0	0	0	0	0	0	0	0	0	Effective technology and scale
G2	1	0	0	0	0	0	0	0	0	0	Effective technology and scale
G3	0.6635	0.0522	0	0	0.0408	0.0129	0.0179	0.0179	0	0.0828	Non DEA scale effective
G4	1	0	0	0	0	0	0	0	0	0	Effective technology and scale
G5	0.9936	0	0.0903	0	0.0307	0.0363	0.0230	0.0409	0	0	Non DEA scale effective
G6	0.8447	0	0	0	0.0459	0.0143	0.0244	0.0268	0.0371	0	Non DEA scale effective
G7	1	0	0	0	0	0	0	0	0	0	Effective technology and scale
G8	1	0	0	0	0	0	0	0	0	0	Effective technology and scale
G9	1	0	0	0	0	0	0	0	0	0	Effective technology and scale
G10	1	0	0	0	0	0	0	0	0	0	Effective technology and scale
G11	1	0	0	0	0	0	0	0	0	0	Effective technology and scale
G12	0.7724	0	0.0870	0	0.0750	0	0.0973	0.0195	0	0	Non DEA scale effective
G13	1	0	0	0	0	0	0	0	0	0	Effective technology and scale
G14	0.8936	0	0	0	0.1671	0	0	0.2068	0	0	Non DEA scale effective
G15	0.9647	0	0	0.4136	0	0	0.0824	0.0900	0.0208	0	Non DEA scale effective
G16	0.9445	0	0.0640	0	0.0322	0	0.0139	0.0046	0	0	Non DEA scale effective
G17	1	0	0	0	0	0	0	0	0	0	Effective technology and scale
G18	1	0	0	0	0	0	0	0	0	0	Effective technology and scale
G19	1	0	0	0	0	0	0	0	0	0	Effective technology and scale
G20	1	0	0	0	0	0	0	0	0	0	Effective technology and scale

Source: formed by the author

APPENDIX C

Table C.1 – Investigation on the marketing and promotion of knowledge service of "double first-class" university library

Universities	Microblog				WeChat		Microfilm	Library website	
	Attention (person)	Speed of consultation and feedback (day)	microblog number	Knowledge service micro blog number	Knowledge service push frequency	Speed of consultation and feedback (day)	Have you used microfilms for knowledge service marketing	Is there a knowledge service column	Is the location eye-catching?
Beijing University of Aeronautics and Astronautics	6537	7	1072	120+	At least once a week	7	No	Yes	Yes
Beijing Institute of Technology	2107	-	221	90-	Average once half a year	-	No	Yes	Yes
Beijing Normal University	406	-	138	120-	Average once every two to three days	-	No	Yes	Yes
Central South University	199	-	2	0	At least once a month	-	No	Yes	Yes
Chongqing University	21000	1	3656	1020+	At least once to twice a week	1	No	Yes	Yes
China Agricultural University	-	-	-	-	-	-	No	Yes	Yes
Dalian University of Technology	2039	-	732	120-	Average once every week	7	No	Yes	Yes
East China Normal University	17000	3	1959	860-	At least Once a week	7	No	Yes	Yes
Fudan University	28000	3	2542	1160+	Average once to twice two weeks	1	No	Yes	Yes
Huazhong University of Science and Technology	65	-	0	0	Average twice a week	-	No	Yes	Yes
Hunan University	4564	-	2268	230-	About once two weeks	7	No	Yes	Yes
Harbin Institute of Technology	1065	-	256	120-	Average once two weeks	-	No	Yes	Yes
Jilin University	3894	-	2154	820-	Average once every week	-	No	Yes	Yes
Lanzhou University	6256	7	2764	520+	Average twice a week	7	Yes	Yes	Yes
Minzu University of China	-	-	-	-	Average once every three weeks	-	No	No	No
Nankai University	5634	7	1298	530-	Average Twice every week	1	No	Yes	Yes
Nanjing University	16000	3	1789	600-	About once two to three weeks	3	No	Yes	Yes
Northwestern Polytechnical University	3924	-	321	60-	Average once a week	-	No	Yes	Yes
National University of Defense Technology	-	-	-	-	At least once a week	-	No	Yes	Yes
Northwest A&F University	2108	-	43	10-	Average once a week	-	No	Yes	Yes
Northeastern University	369	-	297	100-	At least once a week	-	No	Yes	Yes
Ocean University of China	-	-	-	-	Average once a week	-	No	Yes	Yes
Peking University	More than 37000	1	3378	1100+	Four times a week	1	Yes	Yes	Yes
Renmin University of	12000	7	814	100+	average two times a	7	No	Yes	Yes

China					week				
Shanghai Jiao Tong University	9076	3	2741	1020-	Once a week	3	No	Yes	Yes
Southeast University	9461	3	2569	1030-	Average twice a week	3	No	Yes	Yes
Shandong university	2943	-	986	210+	About once a week	7	No	Yes	Yes
Sun yat-sen University	4406	30	1362	110+	At least once a week	7	No	Yes	Yes
South China University of Technology	266	-	247	12-	At least twice a week	-	No	Yes	Yes
Sichuan University	25000	1	9635	1020 +	Average once two to three weeks	1	No	Yes	Yes
Tsinghua University	55000	1	7064	1530 +	Two or three times a week	1	Yes	Yes	Yes
Tianjin University	17	-	73	12-	Average once every week	-	No	Yes	Yes
Tongji University	19000	3	1252 8	5050 +	Average twice one week	3	No	Yes	Yes
University of Electronic Science and Technology of China	-	-	-	-	At least once a week	-	Yes	Yes	Yes
University of Science and Technology of China	3387	30	0	0	Average once to twice a week	-	No	Yes	Yes
Wuhan University	36000	1	5548	1030 +	Average twice to three times a week	1	No	Yes	Yes
Xiamen University	30000	7	2986	1010 +	Average once three weeks	-	No	Yes	Yes
Xi 'an Jiaotong University	9364	1	543	100-	Average once a month	7	No	Yes	Yes
Xinjiang University	-	-	-	-	Average once a month	-	No	Yes	Yes
Yunnan University	-	-	-	-	Average once two to three weeks	-	No	Yes	Yes
Zhengzhou University	More than 12000	7	2280	330-	About once a month	7	No	Yes	Yes
Zhejiang University	3599	30	1067	220+	At least twice a week	-	No	Yes	Yes

*note: the statistical period of consulting messages on microblog and WeChat platforms is 30 days.

Source: formed by the author