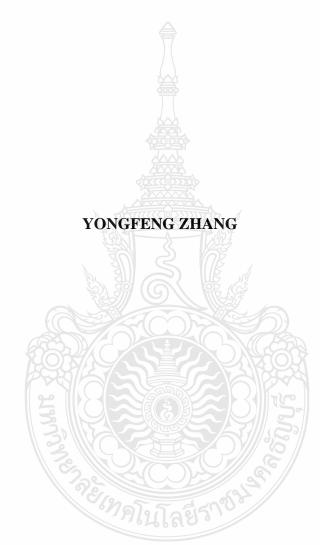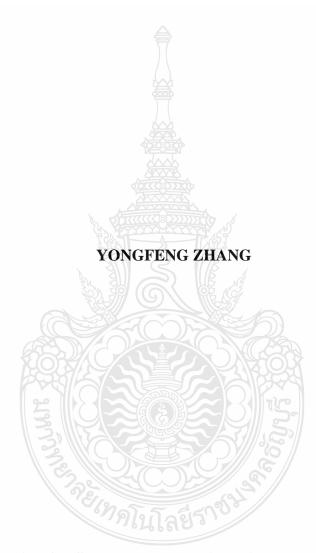# ASSESSING FACTORS AND SIMULATING INNOVATION: A STUDY OF INNOVATIVE CAPACITIES AMONG DATA SCIENCE PROFESSIONALS IN CHINA

YONGFENG ZHANG

ASSESSING FACTORS AND SIMULATING INNOVATION: A STUDY OF INNOVATIVE CAPACITIES AMONG DATA SCIENCE PROFESSIONALS IN CHINA

YONGFENG ZHANG

**A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENT FOR THE DEGREE OF DOCTOR OF EDUCATION
PROGRAM IN VOCATIONAL EDUCATION
FACULTY OF TECHNICAL EDUCATION
RAJAMANGALA UNIVERSITY OF TECHNOLOGY THANYABURI
ACADEMIC YEAR 2023
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วิทยานิพนธ์ฉบับนี้เป็นงานวิจัยที่เกิดจากการค้นคว้าและวิจัย ขณะที่ข้าพเจ้าศึกษาอยู่ใน คณะครุศาสตร์อุตสาหกรรม มหาวิทยาลัยเทคโนโลยีราชมงคลธัญบุรี ดังนั้น งานวิจัยในวิทยานิพนธ์ ฉบับนี้ถือเป็นลิขสิทธิ์ของมหาวิทยาลัยเทคโนโลยีราชมงคลธัญบุรี และข้อความต่าง ๆ ในวิทยานิพนธ์ ฉบับนี้ ข้าพเจ้าขอรับรองว่าไม่มีการคัดลอกหรือนำงานวิจัยของผู้อื่นมานำเสนอในชื่อของข้าพเจ้า

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Dissertation Title   Assessing Factors and Simulating Innovation: A study of Innovative Capacities Among Data Science Professionals in China

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Program   Vocational Education

Dissertation Advisor   Assistant Professor Thosporn Sangsawang, Ph.D.

Academic Year   2023

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ABSTRACT

This study aims to analyze the multifaceted factors influencing the innovative capabilities of data science professionals in China and assess the impact of simulations on their innovative skills.

The samples comprised 17 experts who actively participated in discussions and provided 36 perspectives on factors affecting their innovation abilities. The research methodology utilized the Delphi method, involving four rounds of questionnaires distributed to 363 data science professionals to evaluate the factors affecting their innovation capacity. The data was rigorously analyzed using mathematical statistics and SPSS, with a strong emphasis on questionnaire validity and reliability. In the reliability analysis, Cronbach's α was found to be 0.98, indicating a high level of internal consistency.

The research results yielded an average score of 4.79, $SD = 0.39$, IQR = 1, reflecting a strong consensus among experts in agreement with the research findings. Exploratory factor analysis was employed for validity assessment, revealing that the 12th factor accounted for a cumulative variance explanation rate of 76.54%, exceeding the threshold of 60%, signifying the robust structural validity of the questionnaire data. The study also utilized AMOS software to simulate sample data and assess the influence coefficients of individual, organizational, and family characteristics on innovation capacity, resulting in values of 0.53, 0.39, and 0.22, respectively, all greater than 0, indicating favorable influence relationships. Building upon these findings, a comprehensive model of creative abilities among Chinese data science professionals is proposed. This research critically examines the innovation potential of data science professionals in Chinese academia, with the overarching goal of enhancing their creative skills and competitiveness within the data science field. Additionally, it lays the theoretical groundwork for fostering innovation within the university setting.

Keywords: innovative capacities, data science professionals, innovation factors, data science industry, innovation simulation

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Yongfeng Zhang

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List of Abbreviations

AVE	Average Variance Extract
AMOS	Analyze of Moment Structures
CFI	Comparative Fit Index
CR	Combined reliability
DEA	Drug Enforcement Administration
DF	Degrees of Freedom
ERG	Existence-Relatedness-Growth
GFI	Goodness-of-Fit Index
GOCDR	Guiding Opinions on Comprehensively Deepening the Reform
IQR	Inter Quartile Range
KMO	Kaiser-Meyer-Olin
NNFI	Non-Nor-med Fit Index
ODE	Opinions on Deepening Educational
RMSEA	Root Mean Square Error of Approximation
RCPQE	Reform and Comprehensively Promoting Quality Education
SD	Standard Deviation
SEM	Structural Equation Modeling
SPSS	Statistical Product and Service Solutions

CHAPTER 1
INTRODUCTION

1.1 Background and Statement of the Problem

The Chinese government has permanently attached great importance to the innovative capacities of data science professionals. It has issued a series of relevant policies and documents at the national level to promote the development of data science professionals' innovative capacities. In 2010, China issued the "Outline of the National medium and long-term Educational reform and development plan (2010-2020)", which explicitly pointed out that it is necessary to strengthen the cultivation and development of data science professionals and to improve data science professionals' innovative capacities and teaching level, and promote the innovative development of higher education. In 2018, China issued the Opinions on Comprehensively Deepening (OCD) the reform of teacher team construction in the new Era, which clarified data science professionals as the first resource for education development. In 2020, China issued the GOCDR of the title system of data science professionals in Colleges and Universities, which requires that the reform of the title system of data science professionals should respect the academic law, overcome the tendency of "only papers, only hats, only titles, only qualifications, only awards," and focus on the academic level, innovative viewpoints and theoretical contributions of the data science professionals' academic achievements, and pay attention to the academic achievements of data science professionals. In 2021, the Ministry of Education and six other departments issued the "Guiding Opinions on Strengthening the Reform of university teaching staff construction in the new Era," focusing on the key areas and fundamental aspects of university teaching staff development and putting forward a series of initiatives to support the development of data science professionals. 2021, China issued the Opinions on Deepening Educational (ODE) RCPQE: Reform and Comprehensively Promoting Quality Education, which emphasized the need to strengthen the construction of the teaching force, improve data science professionals' capacity for innovative education, and cultivate high-quality data science professionals with the spirit of innovation and the ability to practice.2022, the Twentieth National Congress of the Communist Party of China (CPC) put forward the

following: "Education, science and technology, and human resources are the basic and strategic support. It is necessary to insist that science and technology are the first productive force, talent is the first resource, and innovation is the first driving force, deeply implement the strategy of developing the country through science and education, the strategy of strengthening the country through talent, and the strategy of innovation-driven development, to open up new fields and new tracks of development, and to continuously shape new dynamics and new advantages in development." "Improve the scientific and technological innovation system, adhere to the central position of innovation in the overall situation of China's modernization, improve the new type of national lifting system, strengthen the national strategic scientific and technological forces, enhance the overall effectiveness of the national innovation system, and form a globally competitive open innovation ecology." These policies and documents are aimed at stimulating the innovative potential of university faculty and enhancing their teaching and research capabilities to promote the development of China's higher education and improve the quality of education.

In the context of economic globalization and informatization, international competition is becoming increasingly fierce, and innovation is increasingly becoming the mainstream of economic and social development, which is not only the inexhaustible spiritual impetus for the progress of a nation but also the soul of the development and progress of higher Education (Fagerberg et al., 2010). Universities' concentration of talents and numerous disciplines is essential in constructing an innovative country (Harkavy, 2006). Universities should make full use of their advantages and strive to become the main base for cultivating all kinds of high-level innovative talents, the main force of basic research, the source of original innovation in the field of high technology, and play a more important role in solving the major scientific and technological problems of the national economy and realizing the results of technology transfer (Rasmitadila et al., 2022). Moreover, data science professionals, as an important force in university science and technology innovation as well as scientific and technological activities, it is crucial to create a high-quality, innovative teacher team in the process of serving the construction of an innovative country and a strong country with talents and the construction of world-class universities and first-class disciplines (Daumiller et al.,

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2021). It is mainly because the innovative capacities of data science professionals involves the following aspects (1) Improve the quality of teaching for university faculty; by focusing on improving their creativity, academics can improve the quality and effectiveness of teaching, resulting in better student learning outcomes (Madani, 2019)., (2) Promoting innovation and creativity among data science professionals, Encouraging and enhancing the creativity of data science professionals can foster a culture of innovation and creativity in academia. It can lead to developing and implementing new and effective teaching methods, methodologies, and tools that ultimately enhance the overall learning experience (Regier & Savic, 2020)., (3) Meeting sstudent's changing needs; With the growth of the Internet, contemporary students have different backgrounds, learning styles, and expectations. By empowering practical data science professionals to be innovative, academics can ensure that teaching methods are attractive, relevant, and responsive to students' changing needs and interests (Grimus, 2020)., (4) Promoting lifelong learning for data science professionals; by emphasizing creativity, scholars can inspire practical data science professionals to constantly improve their teaching practices, seek new knowledge, and adapt to changing educational trends. It promotes a culture of lifelong learning among educators, which is essential in an evolving educational environment (Garzon Artacho et al., 2020)., (5) Advancing teaching research and scholarship; focusing on the creativity of practical university faculty can lead to the development of research projects and scholarships related to innovative teaching practices. It contributes to the knowledge of effective teaching methods and provides practical insights that can be shared with the wider academic community(Aithal & Aithal, 2020)., (6) Improving the competitiveness of universities; In a globalized world, educational institutions and systems constantly strive to be innovative and competitive. Promoting faculty innovation can help Chinese scholars and universities stay ahead of the curve and position themselves as leaders in innovative teaching method (Tseng et al., 2020)., and (7) Dealing with social challenges and needs:;The current social demand for talent is increasingly diverse and complex; data science professionals must be able to innovate to adapt to the needs and challenges of social development (Morawska-Jancelewicz, 2022). For example, innovative teaching methods can be used to promote

students' critical thinking, problem-solving skills, sustainability, and social responsibility.

Therefore, it is necessary to provide theoretical support and practical guidance for improving data science professionals' innovative capacities and education quantity through an in-depth study of the factors affecting their innovation. However, data science professionals' knowledge innovation output efficiency is relatively low. Wang Yupeng uses the Malmquist index method to analyze the dynamic changes in science and technology input-output efficiency of universities in 30 provinces and cities in China from 2002 to 2009 (Yupeng, 2012). Li Wenmin, Yin Gang, and others used DEA basic model and super-efficiency model to make an empirical analysis of the scientific research efficiency of the first batch of 19 undergraduate colleges in Hubei Province in 2016 (Wenming et al., 2017), Yu Dan, Zhang Lihua and others constructed DEA-BCC model to empirically study the input and output of scientific research in Jilin University from 2007 to 2016 (Dan & Lihua, 2021). From the analysis of the above scholars, the output of the innovative capacities of Chinese data science professionals is relatively low, so it is necessary to conduct an in-depth analysis of the innovative capacities of Chinese data science professionals.

However, at present, most scholars focus on the construction, review, and empirical research of the evaluation system of university science and technology innovative capacities (Reijers et al., 2018), and there are few papers on the influencing factors, most of which are from the qualitative point of view. It is mainly positioned in the study of the impact factors of the overall or team innovative capacities of universities (Burget et al., 2017), but the author believes that it is essentially the evaluation of university innovative capacities, and there is no fundamental analysis of the specific essential constraints affecting university innovative capacities. Generally speaking, there are many factors affecting the innovative capacities of data science professionals, including the following factors; (1) Psychological factors; Include a person's cognitive processes, emotions, attitudes, beliefs, and personality traits. Psychological factors can shape a person's thoughts, feelings, and behaviors and affect their decision-making process(Al-Takhayneh et al., 2022)., (2) Social factors; include the influence of family, friends, peers, and society. People are often influenced by and may conform to social groups'

norms, values, and expectations to be accepted and integrated (Ivanova & Popova, 2017)., (3) Environmental factors; the physical and social environment in which a person lives and interacts can significantly impact their behavior. The availability of resources, cultural background, economic conditions, and natural environment can affect people's behavior and choice (Chou et al., 2019)., (4) Economic factors; financial considerations and incentives strongly influence people's behavior. Economic factors such as income, cost of living, employment opportunities, and economic incentives affect people's decisions and actions (Wang et al., 2021)., (5) Cultural factors: Cultural beliefs, traditions, and values can significantly influence people's behavior. Different cultures have different norms and expectations, which can shape the way individuals think and behave(Abbas & Dogan, 2022)., (6) Personal factors; personal characteristics such as age, gender, education, and experience also affect behavior. Personal factors affect people's attitudes, beliefs, and interests and can shape their decision-making process (Razak et al., 2019)., (7) Media and technology; media and technology are essential in shaping people's behavior and opinions. Advertising, social media, and other forms of media can influence people's choices, attitudes, and beliefs (Di Domenico et al., 2021)., and (8) Political factors: Political factors such as government policies, regulations, and political ideology can affect people's behavior. Political factors can shape people's attitudes toward specific issues and influence their decision-making process (Luo, 2022).

This study will be distilled into three main areas after considering the factors affecting university professors' capacity for innovation and the aim of this investigation: (1) individual factors, including innovative thinking, innovative personality, and innovative knowledge; (2) Organizational factors, including organizational climate, innovation incentives, career development, team building; and (3) Family factors, including family atmosphere, work support.

1.2 Purpose of the Study

The objectives of the study are as follows:

1.2.1 To synthesize the factors that affect the innovative capacities of data science professionals and how they affect the innovative capacities of data science professionals.

1.2.2 To identify and develop a model of the factors that affect data science professionals' innovative capacities，by analyzing the factors that affect data science professionals' innovative capacities.

1.2 Research Questions and Hypothesis
1.2.1 Research Questions

This study takes "What are the factors that affect the innovative capacities of Chinese data science professionals?" as the research content, analyzes from three aspects: individual, organizational, and family factors, and analyzes how they affect the innovative capacities of data science professionals.

1.2.1.1 Individual factors affecting the innovative capacities of data science professionals in China; How important are individual factors to data science professionals' innovative capacities? What are the influences of innovative thinking, innovative personality, and innovative knowledge reserve on the innovative capacities of data science professionals?

1.2.1.2 Organizational factors affecting the innovative capacities of data science professionals in China; How important are organizational factors to data science professionals' innovative capacities? How do organizational atmosphere, school management, teaching resources, innovation incentives, career development opportunities, team building, etc., affect data science professionals' innovative capacities?

1.2.1.3 Family factors affecting the innovative capacities of data science professionals in China; How important are family factors to data science professionals' innovative capacities? What are the effects of family atmosphere, family members' work support on data science professionals' innovative capacities?

1.2.1.4 Will individual, organizational, and family factors affect each other? If so, what kind of influence relationship do they have?

1.2.1.5 How do individual, organizational, and family factors affect the innovative capacities of data science professionals? Explained by the model.

1.2.2 Research Hypothesis

Based on the research questions identified in 1.4, the author proposes the following hypotheses:

1.2.2.1 Individual Factors

H1:There is a positive correlation between data science professionals' innovative thinking and innovative capacities, and data science professionals with innovative solid thinking have more vital innovative capacities.

H2: Data science professionals' innovative personality is positively correlated with innovative capacities, and data science professionals with innovative personalities such as adventure, curiosity, and perseverance have higher innovative capacities.

H3: data science professionals' innovation knowledge reserve positively correlates with innovative capacities, and data science professionals with rich innovation knowledge have more vital innovative capacities.

1.2.2.2 Organizational Factors

H4: The school atmosphere is positively correlated with innovative capacities; the better the school atmosphere, the better the innovative capacities of data science professionals.

H5: There is a positive correlation between school innovation incentives and innovative capacities. The greater the innovation incentive, the more it can stimulate data science professionals' innovative capacities.

H6: Career development opportunities are positively correlated with innovative capacities, and the more career development opportunities are provided, the more data science professionals' innovative capacities can be stimulated.

H7: Team building is positively correlated with innovative capacities. The more perfect the team building system and the higher the level, the higher the data science professionals' enthusiasm to innovate.

1.2.2.3 Family Factors

H8: The family atmosphere positively correlates with innovative capacities; data science professionals with a better family atmosphere have more vital innovative capacities.

H9: Job support positively correlates with innovative capacities, and data science professionals who receive more job support have more vital innovative capacities.

1.2.2.4 Interaction

H10: Individual, organizational, and family factors will have related influences, which in turn will affect data science professionals' innovative capacities. The research hypotheses are summarized in Table 1.1.

Table 1.1 Research Hypothesis

Factors	Serial Number	Research Hypothesis
Individual Factors	H1	Innovative thinking has a positive impact on innovative capacities
	H2	Innovative personalities such as adventure and tenacity positively impact innovative capacities.
	H3	An abundant innovation knowledge reserve has a positive impact on innovative capacities.
Organizational Factors	H4	The perceived university atmosphere is good, which positively impacts innovative capacities.
	H5	Perceived innovation incentives are significant and have a positive impact on innovation capabilities.
	H6	Perceived career development opportunities have a positive impact on innovative capacities.
	H7	Perceived high levels of team building have a positive impact on innovation capacity.
Family actors	H8	A good family atmosphere has a positive impact on innovative capacities
	H9	Family members have strong support for work, which has a positive impact on innovative capacities
influence among factors	H10	The interplay between individual, organizational, and family factors

1.3 Significance of the Study

1.3.1 The Conducive to the Further Improvement of Independent Innovation Capability in China. In 2021, the total number of R & D personnel in China was 5.72 million person-years, 1.8 times that of 2012, ranking first globally. The number of R &

D personnel per 10,000 employees increased from 43 person-years in 2012 to 77 person-years in 2021. The number of highly cited scientists from the Chinese mainland has increased from 111 in 2014 to 1,169 in 2022, accelerating the emergence of the world's top scientific and technological talents; data source was People's Republic of China government website). However, at the same time, we must also clearly see that compared with the developed countries in the world, there still needs to be a particular gap in China's independent innovation capability (Ai et al., 2022). According to expert estimates, more than 50% of the gross national product (GDP) of the central member countries of the Organization for Economic Cooperation and Development (OECD) depends on science and technology. The growth of technology and knowledge drives 80% of the productivity growth in the United States (Hassan et al., 2022). In contrast, China's innovation capability could be more robust, the contribution rate of new science and technology is less than 35%, and labor-intensive industries mainly drive the annual high-speed economic growth (Source: https://www.oecd.org/) to solve this problem and improve the overall strength of China's independent innovation, we should not only continue to strengthen the policy guidance and material input of independent innovation but also take appropriate measures to stimulate the development of data science professionals' innovative capacities to promote the cultivation of innovative talents and the output of scientific research achievements (Zhao & Wang, 2022). Therefore, it is of great significance to study the development of data science professionals' innovative capacities for promoting the improvement of China's independent innovative capacities.

1.3.2 The Conducive to Improving the Level of Running Universities in China. The glory of a university lies not in its buildings or numbers but in the quality of the generations of data science professionals (Conant, 1959). The university, excellent data science professionals guarantee a high-quality school-running level. University is the palace of producing, spreading, and applying knowledge; innovation is needed to develop the university. This essential characteristic of colleges and universities determines that data science professionals must have the spirit of criticism and transcendence and have the ability of openness and innovation for the future; only in this way can data science professionals ensure the continuous progress of teaching and scientific research and

promote the continuous improvement of the level of running colleges and universities (V C Iegis & Gineitien E, 2006). University is the specific institution to improve the level of higher education, and the modernization of higher education depends on improving the level of running a school. Therefore, it is significant to study the development of data science professionals' innovative capacities to promote the level of school running and the modernization process of China's higher education.

1.3.3 Promoting Education Reform; innovation plays a vital role in promoting teaching reform in Chinese universities. Through teaching innovation, new teaching methods, techniques, and resources can be continuously introduced to improve the quality and effect of teaching (Stronge, 2018). Innovation can stimulate data science professionals' enthusiasm and creativity, encourage them to try new teaching strategies and designs and make the teaching process more dynamic and attractive. At the same time, innovation can meet different students' learning needs, promote personalized teaching and exploratory learning, and enhance student's learning motivation and interest (Gamrat et al., 2014).Through innovation, interdisciplinary teaching and interdisciplinary research can be promoted, the boundaries of disciplines can be expanded, and the integration and cross-application of knowledge can be promoted. Innovation is the driving force and source of promoting the teaching reform of Chinese universities and lays a solid foundation for cultivating outstanding talents with innovative spirit and practical ability (Cai, 2013).

1.3.4 The Conducive to Cultivating Students' Innovative Capacities. As the guide and role model of students, data science professionals' innovative practice in teaching has a profound impact on the development of students' innovative abilities. First, data science professionals' innovative capacities directly affect teaching content and methods. data science professionals' new teaching strategies, techniques, and resources can stimulate students' interest and initiative in learning and cultivate their innovative consciousness and creativity. Data science professionals' innovative teaching methods can guide students' ability to think, explore and solve problems and cultivate students' critical thinking and innovative thinking. Second, data science professionals' innovative

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practices provide students with a personal learning experience. By participating in data science professionals' innovative teaching activities, students can personally experience the process and fun of innovation. This kind of experience can stimulate students' enthusiasm for learning and enhance their ability to explore and dare to cultivate more innovative students actively. Third, data science professionals' innovative practices can also set good examples for students. Students will be subtly influenced when data science professionals actively participate in innovative teaching, showing their desire for knowledge and pursuing new knowledge. data science professionals' innovative capacities can stimulate students' learning motivation and academic enthusiasm and encourage them to pursue knowledge and continue to explore. Through data science professionals' innovative practice, students can gain richer and deeper learning experiences, cultivate students with more innovative consciousness and creativity, and make positive contributions to the progress and development of society. To sum up, studying the influencing factors of data science professionals' innovative capacities is significant. Understanding the factors that affect data science professionals' innovative capacities can provide practical guidance and support for educational institutions and encourage data science professionals to try new teaching methods and strategies more actively in teaching practice (Goh & Sigala, 2020). At the same time, research can help data science professionals recognize themselves, find their innovative potential and limitations, and actively seek personal growth and development (King & Boyatt, 2015). In addition, an in-depth understanding of influencing factors can provide a scientific basis for formulating teacher training and development plans, thereby enhancing data science professionals' innovative capacities. In the end, the research results will also help promote educational reform, improve the quality of education, and contribute to cultivating innovative talents and promoting social development (Ferrari et al., 2009).

1.4 Theoretical Perspective

1.4.1 This research is based on the following theories; Hierarchy of needs theory (Maslow, 1943), Two-factor theory (Herzberg & Howe, 1959), Achievement needs theory (Herzberg, 1951), and ERG theory (Alderfer, 1969).

1.4.2 There four theories were the factors affecting the innovative capacities of data science professionals involve many aspects and dimensions. Based on the above four theories, this study applies the theory to analyze the influencing factors of data science professionals' innovative capacities. Three aspects carry on the analysis from the organization, family, and individual angles.

1.4.3 Delphi method is used to synthesize the model of influencing factors of data science professionals' innovative capacities (Skulmoski et al., 2007). They all have doctorates and have worked as assistant professors for at least five years.

1.5 Definition Perspective
The following is a list of limitations of this study:

1.5.1 The research on the influencing factors of data science professionals' innovative capacities refers to the following aspects.

    1.5.1.1 What are the factors that affect the innovative capacities of data science professionals? To what extent do they affect the innovative capacities of data science professionals?

    1.5.1.2 The analyzing the factors that affect the innovative capacities of data science professionals, this paper establishes the model of the factors that affect the innovative capacities of data science professionals in China.

1.5.2 Innovation refers to the behavior of improving or creating new things, methods, elements, paths, and environments in a specific domain, guided by the existing thinking mode, which is different from the conventional or ordinary people's thinking, and using existing knowledge and materials to meet the idealized needs or social needs. It can achieve specific beneficial results (Godin, 2008). A philosophical point of view, innovation is a kind of creative, practical behavior of human beings that aims at increasing the total amount of interests and needs in the utilization and re-creation of things and discoveries, especially the utilization and re-creation of contradictions in the material world (Blok, 2018). Human beings create new contradictory relations and form

new material forms through using and recreating the material world. From the perspective of sociology, innovation refers to the activities in which people use general information and conditions to break through conventions and discover or produce some novel, unique, and valuable new things and ideas to meet development needs (Huggins, 2010). The essence of innovation is to break through the old thinking pattern and the old conventional precepts. The core of innovation activities is new, either the change of product structure, performance, and external characteristics, the creation of form design, content expression, and means, or the enrichment and perfection of content. The economic perspective, innovation refers to improving or creating new things (Including but not limited to various methods, elements, paths, and environments). With existing knowledge and materials in a specific climate and achieving certain beneficial effects (Schumpeter, 1912).

1.5.3 Innovation Consciousness refers to people's intention, desire, and imagination in creating unusual things or ideas according to social and individual life development needs. It is a positive and fruitful form of expression in human consciousness activities, and it is the starting point and internal motive force for people to carry out creative activities (Peneder, 2008). It is the premise of creative thinking and creativity.

1.5.4 Innovative Behavior refers to innovative behaviors, such as seeking the best ideas, methods, and technologies to solve new problems in dynamic situations through divergent, associative, and migratory thinking based on exploring new frontier knowledge and technology resources without restricting traditional knowledge and experience. Curiosity, rich imagination, keen understanding, courage to challenge unknown risks, bold ideas, and rigorous verification are the typical characteristics of innovative behavior (Scott & Bruce, 1994a). Innovation behavior generally has three stages of development: creative generation, innovation preparation, and innovation implementation. Based on the working environment and professional characteristics of data science professionals, this paper defines the innovative behavior of data science professionals as the production, promotion, and application of innovative ideas and measures in the process of teaching, scientific research, and social service in order to

improve work efficiency and quality and meet the needs of organizational and social development (Thurlings et al., 2015).

1.5.5 Innovative Capacities of Data Science Professionals refer to some scholars believe that; core literacy does not point to a particular discipline, nor is it to solve specific problems in a specific field, but a combination of knowledge and practical skills that individuals should possess in the process of social development, attitudes, motivations, and thinking about things, as well as the ability to improve themselves and adapt to social development (Guo, 2021). Some scholars also think: Innovation refers to the activities in which people use known information to break through the routine and discover or produce some novel and unique new things and ideas with social value or personal value to meet the needs of development (Wu, 2017).
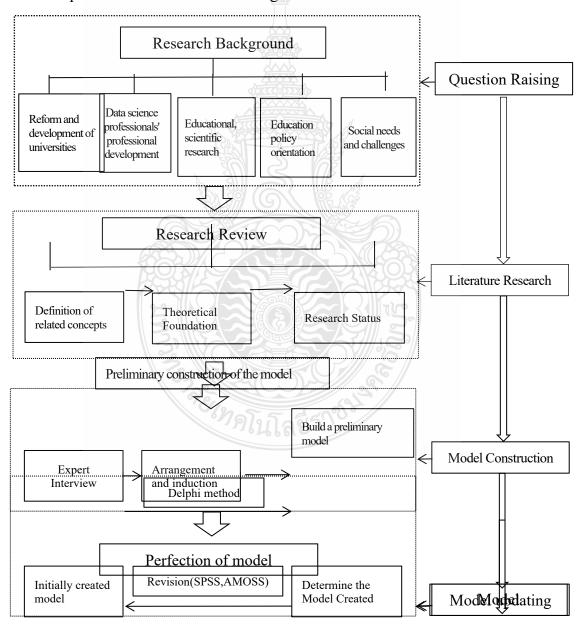
The author believes that the innovative capacities of data science professionals is the overall performance of all kinds of consciousness, thinking, and methods of discovering, raising, and solving new problems, and based on the primary functional attributes of data science professionals, their innovative capacities is mainly reflected in the field of education, teaching, and scientific research. Teaching innovative capacities, is the creativity of data science professionals gradually formed in long-term teaching activities, and scientific research innovative capacities mainly includes academic and technological innovation, which requires data science professionals to have active, innovative thinking. Innovative thinking is the core element of data science professionals' innovative capacities, that is, the subjective initiative consciousness that dominates creative methods and problem-solving strategies, and the ideological source of making scientific judgments in complex things, effectively exploring, exploring and using various scientific methods, and gradually forming characteristics, advantages, and competitiveness.

1.5.6 The Delphi Technique refers to Meaning is a process primarily used in research and economics to collect opinions on a particular research question or topic to gain consensus. The opinions are collected from a group of not physically assembled

experts, usually through questionnaires (Goodman, 1987). A specific number of experts qualified in educational psychology from the same university determined the results. They all had worked for over five years at least as Assistant Professors.

1.7 Conceptual Framework

This study analyzes and synthesizes all relevant literature to analyze the influencing factors of Chinese data science professionals' innovative capacities and constructs the model of influencing factors of Chinese data science professionals' innovative capacities; the conceptual framework is shown in Figure 1.1.

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     A Model of Factors Affecting data science professionals'
                    innovative capacities

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Figure 1.1 Influencing Factors of Data Science Professionals' Innovative Capacities
in China

The research focuses on the following:

1.8.1 This study provides an analytical understanding of the factors that affect the innovative capacities of data science professionals in China.

1.8.2 This study can provide reference and help Chinese universities to improve data science professionals' innovative abilities.

1.8.3 This study helps improve Chinese universities' competitiveness and the theoretical system of university innovative capacities.

CHAPTER 2
LITERATURE REVIEW

This chapter mainly researches the literature, which is helpful for the literature review in the research design and presentation process to determine the influencing factors that affect the innovative capacities of Chinese data science professionals. This chapter is divided into the following sections:

2.1 Theoretical Perspective of Research

2.2 Delphi method

2.3 Literature Review of research relevance

2.4 Influencing Factors of data science professionals' innovative capacities

2.5 Evaluation Index of data science professionals' innovative capacities

2.1 Theoretical Perspective of Research

This review focuses on the following four theories: hierarchy of needs theory (Abraham et al., 1943), two-factor theory (Fredrick Herzberg, 1959), Achievement needs theory (David et al., 1951), and ERG theory (Clayton. Alderfer, 1969).

2.1.1 Need Hierarchy Theory

Maslow proposed the "Need Hierarchy" theory in 1943. He divided complex human needs into physiological, safety, social, and respect needs, and There are five levels of self-actualization. Maslow believes that the five needs are ascending in order, and only after the lower-level needs are partially satisfied the higher-level needs may become an important determinant of behavior. However, this gradual increase in the level of needs does not follow the "all" or "none" law; after one need is 100% satisfied, another need will appear(Gambrel & Cianci, 2003). The majority of people in society usually have every basic need partially met. At the same time, Maslow regards physiological, safety, and social needs as low-level. These needs can be met through external conditions, such as satisfying physiological needs with the help of wage income and satisfying safety needs using the legal system; respect needs 1. Self-actualization needs are higher-level needs, they are satisfied from within, and a person's needs for care and self-actualization can never be fully satisfied(McLeod, 2007).

Maslow's hierarchy of needs is shown in Figure 2.1.
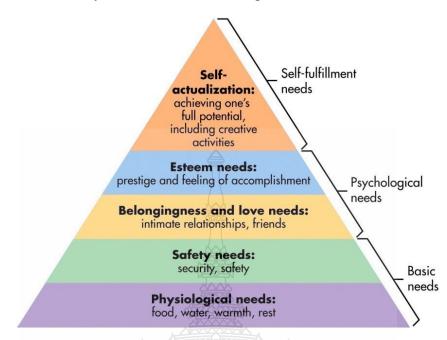
Figure 2.1 Maslow's Hierarchy of Needs

Image source: Motivation and Personality (Maslow, 1954)

2.1.2 Two-factor Theory

In the late 1950s, Herzberg and his assistants surveyed 200 engineers and accountants in Pittsburgh, United States. As a result, he found that what makes employees feel satisfied belongs to the job itself or the content of the job; what makes employees feel dissatisfied belongs to the work environment or work-related aspects. He called the former motivating and the latter hygiene factors, and combining the two became a "double factor."(Kelso & Hetter, 1967) The effect of the satisfaction of hygiene factors on employees is similar to that of health care on physical health, such as company policies, management measures, supervision, interpersonal relationships, material working conditions, wages, benefits, etc. Job dissatisfaction arises when these factors deteriorate below acceptable(Hirshman & Bjork, 1988). However, perceiving these factors as good removes the blow and does not lead to positive attitudes. Those factors that lead to positive attitudes, satisfaction, and motivation are called "motivators" and include Achievement, recognition, challenging work, increased job responsibilities, and opportunities for Growth and development. If these factors are present, people can be

more motivated. According to Herzberg, managers should realize that hygiene factors are necessary, but only "motivation factors" can make people have better work performance(Maddox, 1981).

Herzberg's two-factor theory is shown in Figure 2.2.

Figure 2.2 Herzberg's Two-factor Theory

Image credit: Charlotte Nickerson (2023)

2.1.3 Achievement Needs Theory

This theory divides people's basic needs into Achievement, power, and affinity needs. Achievement needs refer to striving for success, pursuing superiority, and hoping to do the best Power needs refer to the need to influence or control others without being controlled by others. Affinity must refer to establishing friendly and intimate interpersonal relationships and seeking to be liked and accepted by others(Covington & Omelich, 2015). Among them, the need for Achievement is vital in developing individuals, groups, and societies. People with a high demand for Achievement generally care about career success or failure, are willing to take responsibility, have clear goals, like creative work, and are not afraid of fatigue. The more people of this type, the more likely the business will be successful. Effective education can cultivate and improve achievement needs (Acquah, 2017).

The need for achievement theory is shown in Figure 2-3.

Figure 2.3 McClelland's Achievement Needs Theory

Image credit: Kiara Miller (2022)

2.1.4 ERG Theory

   Clayton. Alderfer of Yale University proposed a new humanistic need theory based on Maslow's hierarchy of needs theory. Alderfer believes that there are three core needs in people, namely the need for Existence (this includes the physiological conditions and safety needs that Maslow considers), the need for Relatedness (this is the same as Maslow's love needs and respect needs), Consistent with the external factors in it) and the requirements of Growth (this includes the internal factors of Maslow's esteem needs and the contents of self-actualization needs)(Caulton, 2012). ERG theory is the abbreviation of the three core needs theory of survival, interrelationship, and Growth. It is named after these three English words' initials E, R, and G. The content of ERG theory is roughly the same as Maslow's hierarchy of needs. However, the difference is that Maslow believes that people's needs are from low to high to unsatisfied, while EGR theory needs to emphasize the order of the hierarchy of needs(Arnolds & Boshoff, 2002). The ERG theory is shown in Figure 2.4.

Figure 2.4 ERG Theory and Hierarchy of Needs Theory

Image credit: business jargon

2.2 The Delphi Method

2.2.1 Definition of the Delphi Technique

The Delphi method is a qualitative evaluation method initiated by Helm and Dalk in the 1920s. The American Rand Corporation later developed it because of its reliable anonymity and good feedback. Therefore, it has become a widely used prediction and evaluation research method in many fields. This technique uses written questionnaires to prevent personal influences or the power of forceful personalities. The method results from a questionnaire system that sends several questionnaires to a panel of experts. Their anonymous responses are collected and sent to the panel after each round. The panel members are allowed to adjust their answers in subsequent rounds. The multiple rounds of questions result in multiple solutions, and the consensus for each round is given to each panel member, which eventually elicits a final "correct" response(Rowe & Wright, 1999). It is said that the Delphi technique is a method for building a group communication process that allows a group of individuals to work together to find an answer to a complex problem (Linstone et al., 1975). This technique gives more and different choices to researchers than does survey research. The communication process, a group of experts, and essential feedback are all necessary for this technique(Joshi et al., 2007). In 1953 and to gain the views of military officers about

ordnance requirements in wartime, the Delphi technique was formulated. It has been used since then and adopted as a method to prepare for a large number of difficult situations which might occur in the future. It comprises several questionnaires sent to a selected group of well-known professional experts. The replies to each round are developed and used for questions in the next round, and so on, until a final consensus is reached (Witkin & Altschuld, 1995).

2.2.2 The Delphi Technique and Decision Analysis

The Delphi method is structured and iterative for gathering expert opinions and reaching a consensus on a particular topic. Although it has been widely used in various fields, it has advantages and disadvantages, as shown in Table 2.1.

Table 2.1 Advantages and Limitations of the Delphi Method

Strengths of the Delphi technique	Limitations of the Delphi technique
Anonymity: The Delphi method allows participants to provide opinions anonymously, which reduces bias and minimizes the influence of dominant individuals. It promotes equal participation and encourages a diversity of perspectives.	Potential bias: Even though the responses are anonymous, there can still be bias in the Delphi method. Personal preferences, group dynamics, or preconceived notions may influence expert opinions. The role of the coordinator is critical to managing bias and ensuring a fair process.
Expert opinion: This approach allows for including experts from diverse backgrounds and geographic locations, comprehensively exploring the topic. It ensures a more robust and informed decision-making process.	Lack of face-to-face interaction: The Delphi method relies on written communication and must provide direct face-to-face interaction between participants. This limitation can hinder the exchange of ideas and the exploration of different perspectives.
Iterative process: The Delphi method involves multiple rounds of feedback and consensus building. This iterative approach allows participants to reconsider their opinions based on input from others, resulting in more refined and reliable results.	Limited generalizability: The Delphi method focuses on obtaining expert opinion rather than a representative population sample. Therefore, the generalizability of the findings may be limited beyond the specific expert group involved.

Flexibility: The method is flexible and adaptable to various research settings. It can explore complex issues, make predictions, generate ideas, or gather expert opinions on policy issues.	Time-consuming: The iterative nature of the Delphi method, which requires multiple rounds of data collection and analysis, can be time-consuming. Multiple iterations may be required to reach a consensus, prolonging the research process.
Systematic and structured: The Delphi method provides a systematic and structured framework for data collection and analysis. It uses standardized questionnaires and statistical techniques to facilitate data synthesis and interpretation.	

2.2.3 The Application of the Delphi Technique

Beech B and Keele University believed that the Delphi method is an essential tool in forecasting activities and is widely representative and reliable (Beech et al., 1999). Bowles N; School of Health Studies, Division of Nursing, University of Bradford believed that the Delphi method could give full play to the advantages of the conference discussion method and allow experts to express their views and differences fully (Bowles et al., 1987). The strengths of each family can make up for the shortcomings of each family, and it can avoid the failures of the meeting discussion, prevent the opinions of authoritative people from affecting others, or some people are unwilling to modify their views due to sympathy so that the final results are more objective. Williams PL; University College, Salford, England. Found research that many companies in the United States previously widely adopted the "nominal group method," which consisted of senior managers and experts forming a group to predict the company's future. However, there needed to be more measurement forecast data. To obtain objective standards, most of them now use the Delphi method (Williams & Webb, 1994). As a subjective and qualitative method, the Delphi method can not only be used in the field of prediction but is also widely used in establishing various evaluation index systems and determining specific indicators (Gupta & Clarke, 1996). This study explores the influencing factors of data science professionals' innovative capacities, and the Delphi method is also applicable.

2.2.4 Application and Improvement of Delphi Method in the Study

The Delphi method is structured for gathering and consolidating the opinions of a group of experts or stakeholders on a particular topic. It is often used in decision-making processes, forecasting, and policy development. During the implementation of the Delphi method, there are always two active people, one is the forecast organizer, and the other is the selected experts. First of all, the questionnaire in the Delphi method is different from the usual questionnaire. In addition to the content of the standard questionnaire asking the respondents questions and asking them to answer, it also provides information to the respondents. Responsibility is a tool for experts to exchange ideas. The working process of the Delphi method can be roughly divided into four steps, and in each step, the organizer and the expert have different tasks. (Flostrand et al., 2020)

2.2.4.1 Round 1: Questionnaire distribution: The questionnaire is sent to the experts, who are asked to provide individual responses. Experts can be geographically dispersed, and questionnaires can be conducted electronically via email or online survey platforms. Analyze Responses: Collect expert responses and analyze data. This analysis may involve summarizing responses, identifying areas of agreement or disagreement, and categorizing responses into themes or themes.

2.2.4.2 Round 2: Provide feedback: Based on the analysis of the responses from Round 1, prepare a summary report highlighting points and areas of agreement or disagreement. Share this report with experts while remaining anonymous. Experts can review the report and revise their initial responses based on the feedback provided.

2.2.4.3 Round 3 (repeatable round, as many times as needed): Depending on the complexity of the topic and the degree of consensus reached, there may be multiple rounds of questionnaires and feedback. This iterative process can lead to convergence of opinion and narrow the range of diverging views.

2.2.4.4 Round 4: Convergence and Consensus: As the round progresses, responses tend to converge, and consensus emerges. The goal is to get to the point where no significant new information or perspective is added, and there is agreement or consensus among experts.

2.2.4.5 Final report: Prepare a final report summarizing the findings of the Delphi study. The report should include areas of agreement, the rationale behind any disagreement, and any recommendations or conclusions based on the collective opinion of the experts. Finally, relevant stakeholders, decision-makers, or organizations can share the final report. Research findings can inform decision-making processes, policy development, or future research.

2.3 Literature Review of Relevance of Research

2.3.1 Innovation

Innovation can be understood as an activity in which people, driven by the concept of progress, face the changed objective environment and explore new ways, solutions, and countermeasures. Problem Solving (Amabile & Others, 1988) . Scholars believe that employees' innovative work behavior is the basis of organizational change and innovation, and innovation can help companies gain sustainable competitive advantages over competitors (Janssen & Van Yperen, 2004; Scott & Bruce, 1994b; Yuan & Woodman, 2010a). Long-term survival and development have made outstanding contributions (West & Farr, 1989). Although innovation is central to the competitiveness of any organization (Agarwal & Dhar, 2014), an organization needs employees to innovate (Abstein et al., 2014). Employees' innovative work behavior is the basis for enterprises to improve organizational performance and maintain sustainable development (Khodakarami & Zakaria, 2015). In the fierce market competition, employees' innovative work behavior is essential for the enterprise's success. This view applies to innovative organizations and all organizations (De Jong & Den Hartog, 2010; Mumford et al., 2003). Knowledge workers in service-oriented enterprises are the core of the development process of innovative services. The tasks of knowledge workers involve innovation and problem-solving. Thus, their commitment and contribution have an essential impact on the long-term development of enterprises (Seroka-Stolka, 2016). Theorists argue that successful innovation in organizations is facilitated by the efforts of these knowledge workers who may generate ideas and concepts (Van de Ven & Rogers, 1988; De Brentani, 2001). Knowledge workers work in various industries and

professions, such as law, accounting, academia, healthcare, and information technology (Wickramasinghe & Ginzberg, 2001).

Therefore, employees' innovative work behaviours are increasingly playing a pivotal role in improving organizational effectiveness and competitive advantage, and employees' innovative work behavior capabilities must be enhanced (Afsar et al., 2020). The existing literature research shows scholars' understanding of the connotation of "innovation" in Table 2.2.

Table 2.2 Scholars' Definition of the Concept of Innovation

View	Representative scholars
Departmental work that aims (within a role, within a team, and an organization) to generate, introduce and apply new ideas, processes, products, or procedures relative to the original work is enormously beneficial.	West & Farr (1990). Abstain (2014) Janssen & Van Yperen （2004）
Employees' innovative work behavior is considered to be in the field of research and development for discovering new knowledge.	Ruttan (1959) Romer (1990)
Employees' innovative behavior involves various forms of innovation, including product design, service form, market strategy, working method, etc. It is more considered to be the product of the development of human innovative thinking and innovative capacities.	Kanter (1988) Rogers (2003) (De Brentani, 2001)
The actions of individuals within a role, team, and organization to arrive at new and valuable ideas, processes, products, or procedures and to implement those ideas.	De Spiegelaere et al. (2014) West & Farr (1990) De Jong & Den Hartog (2008)
Employees' innovative work behavior is different from creativity, which refers to the valuable idea of generating new ideas, services, processes, and procedures and promoting the realization of these processes.	Amabile (1988) (Janssen & Van Yperen, 2004) (Scott & Bruce, 1994) (Yuan & Woodman, 2010)
Innovative work behavior intends to provide some new form of practice, so application is a necessary component expected to produce innovative outputs. Productivity is a critical component of innovative work behavior.	De Jong & Den Hartog (2010） Agarwal & Dhar (2014)
Inspiring people with different backgrounds through openness can enhance the ability to respond quickly to changing markets, generate an open innovation culture mindset, and enable innovation.	Ahmed Iqbal, et al. (2020)

Source: Developed by the author of this Study

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2.3.2 Innovation Capability

The earliest research on innovative capacities came from enterprises. From the 1930s to the 1950s, American enterprises launched an innovation education movement to cultivate innovative capacities. In 1933, H. Okun, a senior member of the American Electrical and Electronics Association, completed the invention lectures and applied to the Massachusetts Department of Education to open an invention training course in Boston; In 1938, Osborne, the vice president of the American BBDO advertising company, proposed the invention technique "brainstorming method" and published "Creative Imagination." In 1950, the American industry and education circles jointly took action, and colleges and universities set up a creative engineering major and began to train employees and cadres on creative inventions. However, after Gilbert and other American psychologists participated in the research of innovative capacities, the relationship between innovative capacities and school education, creative teaching, and other content began to be paid attention to and gradually became an essential part of innovative capacities research.

Schumpeter pointed out that "innovation" is the process of achieving a new "production mix" by establishing a new "production function" (Schumpeter, 1934). The word "ability" in China's "Webster's Dictionary" means "the talent or potential to do a certain assigned task," which emphasizes "the limit of ability that can be achieved." In addition, some scholars used the word "capacity" to refer to "ability" in the early days(Schumpeter, 1934). Most of the research on innovative capacities in the academic circle mainly describes innovative capacities in implicit ways. Leonard was the first to separate innovation capabilities from core capabilities. He pointed out that innovation capabilities can be understood from the dimensions of skills and knowledge, technology systems, management systems, and value(Leonard-Barton, 1992) but did not define innovation capabilities Definition. Since then, Dutta and Narasimhan pointed out that capability is a kind of "transformation efficiency" between resources and goals based on resource-based theory and used R&D capabilities to conduct quantitative analysis of innovation capabilities (Dutta et al., 2005). Feng, Lijie, Lu, Jiarui Wang, and Jinfeng think that the connotation of innovative capacities has gone through the evolution process

of "ability-core ability-absorbing ability-dynamic ability-innovative capacities" after sorting out the literature related to enterprise innovative capacities (Feng et al., 2021). Cajaiba-Santana thinks the connotation of innovative capacities varies with the theoretical background of its research but generally still has a clear theoretical concept boundary(Cajaiba-Santana, 2014). In general, the existing literature reflects that the theoretical basis of innovative capacities includes Resource-based theory, core capability theory, knowledge-based theory, dynamic capability theory, absorptive capacity theory, dual innovation theory, etc. Among them, the research on innovation capability from the perspective of dynamic capability theory and absorptive capacity theory gives a relatively clear definition of, specifically.

It started from the theory of dynamic capabilities. It first proposed the theory of dynamic capabilities and believed that companies could integrate internal and external resources to cope with rapidly changing environments (Teece et al., 1997). Based on the dynamic capability theory, Lawson and Samson pointed out that innovation capability continuously transforms knowledge and ideas into new products, processes, and systems (Lawson & Samson, 2001). Bogers believe that understanding innovative capacities from the perspective of dynamic capabilities means that innovative capacities includes not only the ability to generate innovation but also the ability to utilize innovation (Bogers et al., 2019). The connotation of innovative capacities based on dynamic ability emphasizes the "dynamic" attribute of innovative capacities, which shows that innovative capacities is not a single-dimensional but a multidimensional and comprehensive ability. Bessant & Rush pointed out that enterprise innovation capability is the system's overall function that supports the realization of the enterprise's innovation strategy and is determined by the coupling of product innovation capability and process innovation capability(Bessant & Rush, 1995). This definition regards enterprise innovation capability as a system capability resulting from the coupling effect of multiple capabilities. Li Yang, Wu Huabin, etc., agreed with this point of view and further pointed out that innovative capacities are a comprehensive innovative capacities (Chen et al., 2018).

Based on the absorptive capacity theory, Levinthal researched enterprise innovation and enterprise learning from the perspective of enterprise R&D, proposed the theory of

absorptive capacity, and pointed out that absorptive capacity includes the ability of enterprises to imitate new technology or product innovation and the ability to develop external knowledge (Leventhal, 1990). Some scholars define the connotation of innovative capacities based on absorptive capacity and describe innovative capacities as the skills and knowledge needed to effectively absorb, master, and improve existing technologies and create new technologies (Romijn & Albaladejo, 2002). Based on the theory of absorptive capacity, Bruno and Cassiman pointed out that the enterprise's R&D activities and external knowledge absorption together constitute enterprise innovation activities (Cassiman & Veugelers, 2006).

Other theoretical perspectives. Assink puts forward the concept of disruptive innovation capability and believes it is to try to solve the potential opportunities in market gaps, generate and explore radical new ideas and concepts through internal driving forces, and develop them into marketable products the ability to innovate efficiently and effectively while utilizing internal and external resources (Assink, 2006). Based on integrating previous studies on innovative capacities, some scholars put forward from a holistic perspective that innovation is a comprehensive process of applying collective knowledge, skills, and resources, including related technological and non-technical innovation, in the company's innovative activities (Ngo & O Cass, 2008). Judging from the scholars mentioned above's conceptual definition of innovation capability. These studies still absorbed the theory of dynamic and absorptive capability. In addition, some scholars define the connotation of innovation capability from the perspective of other capabilities. These studies include studying the overall innovation capability of an organization from the standpoint of organizational capability, skills, and resources to carry out innovative activities (Koc, 2007).

The existing literature research shows scholars' understanding of the connotation of " innovative capacities" in Table 2.3.

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Table 2.3 Scholars' Definition of Innovative Capacities

View	Representative scholars
Increased organizational (resource) redundancy is the basis for technological innovation.	Cyert and March (1963)
A firm's ability to use its collective knowledge, skills, and resources to innovate relative to its competitors	Hogan et al. (2011)
The ability to continuously translate knowledge and ideas into new products, processes, and systems	Lawson and Samson (2001)
Enterprises support the realization of innovation strategy, the overall function of the system that is determined by the coupling of product innovation capabilities and process innovation capabilities	Wei Jiang, Xu Qingrui (1995)
The ability of a business to generate innovation through continuous learning, knowledge transfer, creativity, and the use of internal and external resources	Iddris (2016)
The skills and knowledge required to effectively absorb, master, and improve existing technologies and create new ones	Romijn and Albaladejo (2002)
Enterprise R&D activities and external knowledge absorption together constitute enterprise innovation activities.	Bruno and Cassiman et al. (2006)
innovative capacities includes incremental innovative capacities and breakthrough innovative capacities	Sen and Egelhoff (2000) Lu Yibo and Shi Xiaoxiao et al. (2017)

Source: Developed by the author of the Study

2.3.3 Innovative Behavior

How to stimulate high-level innovative behavior in employees is a significant practical problem. Scott and Bruce defined innovative behavior as a broader behavior that begins with the identification and formulation of a problem, or the adoption of new ideas and new solutions, followed by individuals seeking assistance and support for their new ideas, and finally, through the "innovative Prototypes or models" to implement their ideas and transfer their ideas to productive use or institutionalization through dissemination, mass production, etc. (Scott & Bruce, 1994). Scott and Bruce believe innovative behavior covers all stages of innovative idea generation, promotion, and implementation. However, innovative behavior is not limited to a particular stage and can be a combination of any stage. This definition is classic, and the following definition of innovative behavior is mainly based on this concept of enriching further and

developing. For example, Savolainen proposed that innovation behavior includes generating, promoting, implementing, and disseminating ideas, a multidimensional and holistic organizational activity (Savolainen, 2000). Kleysen and Street also proposed that innovative behavior is a group of multi-stage activities, and the final performance is to propose new product ideas, invent new technologies, improve work processes, etc (Kleysen & Street, 2001). Unlike previous scholars, De Jong & Den Hartog believe that innovation behavior only includes two stages: generating and implementing innovative ideas (De Jong & Den Hartog, 2007). Feng Lijie, Lu Jiarui, and Wang Jinfeng pointed out that innovative behavior is an extra-role behavior that the organization does not require; at the same time, this behavior involves multiple stages, and each stage can reflect innovation (Zhang et al., 2022). Based on Scott and Brace's three-stage definition, Lin, Hsiu-Chuan Lee, and Yuan-Duen defined innovative behavior as the process in which employees' innovative ideas form helpful products or services with innovation support (Lin & Lee, 2017). Different from the views of previous scholars, Yuan and Woodman proposed that innovative behavior is a process in which employees consciously apply new ideas, new processes, etc., to their work. However, these two scholars then proposed that innovative behavior includes introducing new ideas and proposing and implementing new ideas (Yuan & Woodman, 2010b). Lo Louis Yi-Shi Lin, Sheng-WeiHsu, and Li-Yi suggested that innovative behavior covers all the behaviors involved when employees intentionally introduce new products/services or ways of doing things in the idea generation and implementation(Lo et al., 2016). Kwon and Kim put forward a different point of view. The two scholars believe that innovative behavior is when employees consciously propose and apply novel ideas, processes, and policies for organizational effectiveness, business growth, and long-term sustainable development(Kwon & Kim, 2020).

The existing literature research shows scholars' understanding of the connotation of " innovative behavior" in Table 2.4.

Table 2.4 Scholars ' Definition of Innovative Behavior

View	Representative scholars
It covers all stages of innovative idea generation, promotion, and implementation, but innovative behavior is not limited to a particular stage and can be a combination of any stage.	Scott & Bruce (1994)
The generation, promotion, implementation, and dissemination of ideas are multidimensional and holistic organizational activities.	Janssen (2000)
A multi-stage activity consisting of a series of erratic behaviors, the entire innovation process can be divided into five stages: looking for opportunities, generating ideas, evaluating ideas, looking for support, and applying concepts.	Kleysen & Street (2001)
It includes two stages: generating innovative ideas and implementing innovative ideas.	De Jong & Den Hartog (2007)
A complex set of behaviors includes introducing/generating new ideas and implementing new ideas.	Yuan & Woodman (2010)
An extra-role behavior that the organization does not explicitly require.	Chen Bihui et al. (2013)
The totality of actions involved in introducing new products/services or ways of doing things by employees during the idea generation and implementation process.	Lo Louis Yi-Shi Lin, Sheng-WeiHsu,Li-Yi (2016)
The process by which employees consciously propose and apply novel ideas, processes, and policies for organizational effectiveness, business growth, and long-term sustainability.	Kwon & Kim (2020)

Source: Developed by the author of the Study

2.4 Influencing Factors of Data Science Professionals' Innovative Capacities

2.4.1 Dimensional Analysis of Data Science Professionals' Innovative Capacities

Synthesizing the current research status at home and abroad, we can see that the main factors affecting employee innovative capacities include individual and environmental factors, among which environmental factors can be further divided into leadership, team, organization, society, etc. This study suggests we can analyze the influence factors of data science professionals' innovative capacities from individual and environmental factors. Individual factors are the characteristics and qualities of data science professionals, which are an essential part of their innovative capacities, and thus

significantly impact their innovative capacities (Afshari et al., 2009). Environmental factors are divided into micro-environmental factors and macro-environmental factors. Micro-environmental factors are the factors that can affect the innovative capacities of data science professionals in their working environment (such as university environment, teaching team, scientific research team) and living environment (such as family); The macro-level factors mainly refer to those factors in the macro-environment and situation that may have a particular impact on the innovative capacities of data science professionals, such as the national economic situation, educational development and so on. Among them, micro-environment factors can directly affect individual factors, while universities can control or influence micro-level organizational, team, and family factors through relevant measures to obtain higher original innovative capacities of data science professionals; The macro-level factors generally can not directly affect the data science professionals, but through the role of the university and then indirectly affect the data science professionals(Lambriex-Schmitz et al., 2020). That is to say, for universities, national factors and education industry factors can not be determined or controlled by universities themselves; universities can only regard them as the background environment for survival and development to seek policy support to enhance university innovative capacities based on adapting to national policies and industrial policies. Based on this, this paper will mainly study the impact of micro-environmental factors on data science professionals' innovative capacities.

2.4.2 Analysis of the Influencing Factors of Data Science Professionals' Innovative Capacities; to analyze how to improve the innovative capacities of data science professionals, first of all, we need to analyze the factors that affect the innovative capacities of data science professionals. According to the analysis of 1.5, 2.1, and 2.4.1, the author divides the influence of data science professionals' innovative knowledge into three dimensions: individual factors, organizational factors, and family factors.

2.4.2.1 Individual Factors; in recent years, many researchers have analyzed the factors affecting employees' innovative capacities from different perspectives, including personality characteristics, values, knowledge and skills, cognitive style and motivation, and other personal features. Early studies on the influencing factors of innovative

capacities mainly focused on the influence of personality characteristics on innovative capacities. For example, the innovation capability investment theory proposed by Steinberg (Sternberg & Lubart, 1991) and the innovation capability interaction theory proposed by Woodman (Woodman et al., 1993). Some scholars use the Creative Personality Scale (CPS) developed by Professor Gough of the University of California, Berkeley (Woodman et al., 1993). In the subsequent research on innovative capacities, the CPS scale has also been cited many times to measure the role of creative personality machines in employees' innovative capacities. On this basis, Oldham and others believe that broad interest, high aesthetic sensitivity, tolerance of ambiguity, ease of being attracted by the complexity of things, keen intuition, and self-confidence are the key personality characteristics of high innovative capacities (Oldham & Cummings, 1996). Sally and Gilson believe that people with high innovative capacities generally have personality characteristics, including broad interests and independent judgment, autonomy, and firm feelings about their innovation (Gilson & Shalley, 2004).

Since then, scholars have extended the research perspective to other personal characteristics, such as work motivation, self-efficacy, learning tendency, cognitive style, knowledge and skills, job dissatisfaction, values, role identity, and goal orientation. For example, Amabile believes that the factors that can affect employees' innovative capacities at the individual level include cognitive factors, intrinsic motivation, knowledge, and personality characteristics (Amabile & Others, 1998). Cognitive factors refer to how people look at and think about problems; Intrinsic motivation refers to the individual's enthusiasm for the work and the enthusiasm for complex tasks; Possessed knowledge refers to the relevant skills needed to complete the professional field and the skills related to creativity. Young et al. argue that innovative initiatives often depend, to a large extent, on the knowledge, skills, and commitment of employees to invest in the creative process (Youndt et al., 1996). Frederickson and Junior believe positive emotions can lead people to abandon mechanical action plans and pursue new and innovative thoughts and actions (Lepak & Snell, 2002). Through a survey of nine Egyptian public and private sector organizations, Rice found that employees with self-directed values were more creative than those with obedient or authoritative values(Amabile, 1997; Rice, 2006).

In addition, there are scholars on growth needs (Shalley et al., 2009), collectivist values (Du Jing, Wang Danni, 2009), emotions (Amabile et al., 2005), mood (George. Zhou, 2007) and other aspects of the impact of employee innovation factors were discussed.

Based on previous studies, this study focuses on three aspects: innovative thinking, innovative personality, and innovative knowledge, which are the factors affecting data science professionals' innovative capacities.

2.4.2.2 Organizational Factors; Amabile believes that the conditions provided by the organization and the managerial intervention have the most direct and vital impact on the motivation of the members of the organization, which affects the original motivation of the members and can promote the employees to consciously and voluntarily improve their professional knowledge and creative thinking skills (Amabile, 1997). Domestic and foreign scholars have studied the factors that can affect employees' innovative capacities at the organizational level, including innovative atmosphere, resource support, culture, and team.

(1) Innovation Atmosphere; a large number of empirical studies have shown that organizational innovation climate has an important impact on organizational employees' innovative behavior. An appropriate organizational climate will promote the creativity of employees. Abbe and Dickson found that climate is the most critical factor in R&D innovation (Abbey & Dickson, 1983). Nonaka's research found that when the organizational culture is willing to take risks and challenges, the organization is more innovative (Nonaka, 1991). Scott and Bruce believe that innovation support in the organizational innovation climate has a significant positive impact on individual innovation behavior, and employees will show more innovation in their work if they can get the organizational support that the supervisor encourages and listens to(Scott & Bruce, 1994c). Amabile found that the exertion of individual creativity and organizational productivity in organizations were positively correlated with organizational encouragement, supervisor encouragement, work team support, freedom, and challenging work and negatively correlated with organizational disorders. Hunter and Marford think that organizational innovation climate is an important factor in promoting the innovative behavior of organizational members (Hunter et al., 2005).

Fredrickson and Ama Bayer believe that positive emotions at work positively affect employees' innovative behavior in the organization (Fredrickson, 2001). Jung, Ki Baek, and others found that the quality of the leader-member relationship and the support of leaders to employees positively impact the innovative behavior of organizational members (Jung et al., 2021). Ye and Pinghao studied the evolutionary game law of strategic interaction between enterprises and employees in innovation. Their research results show that enterprises' insistence on creating an organizational innovation atmosphere will further increase employees' innovative behavior, and the positive effect of employee innovation behavior can encourage organizations to pay more attention to creating a better innovation atmosphere (Ye et al., 2022).

(2) Resource Support

Scott and Bruce believe that besides organizational innovation climate, organizational resource support to employees significantly impacts individual innovation behavior (Scott & Bruce, 1994). It is found that there is an inverted U-shaped relationship between external rewards such as salary increases, performance bonuses, team incentives, long-term incentives, and welfare guarantees and employees' innovative behavior (Ramamoorthy et al., 2005). Akihiro Hashimoto and Shoko Hanedab examined the change in total factor R & D efficiency of Japanese pharmaceutical enterprises from 1983 to 1992. They found that the diffusion and innovation of R & D technology remained relatively the same between 1983 and 1992, although R & D efficiency did not improve. However, the company's R & D expenditure has increased yearly, which reveals that R & D investment has little relationship with the company's innovation performance(Hashimoto & Haneda, 2008). Oldham and Cummings' research also shows that work tasks' complexity, challenge, and autonomy can stimulate employees' innovative behavior (Oldham & Cummings, 1996). Ruggles believes that the management level of knowledge resources and human capital is an essential factor in restricting the results of organizational innovation, so the organization's human resource management practices, such as training and motivation of technological innovators, restrict the original innovative capacities of industrial technicians to a greater extent (Ruggles, 1998). Li Baizhou and Su Yi also pointed out that improving the human resources management system and ensuring efficient information transmission ability

within enterprises can effectively promote the original innovative capacities of large enterprises (Li & Su, 2010). Luis Diaz-Balteiro et al. analyzed the influencing factors of technological innovation efficiency in the Spanish timber industry, and the results showed that the efficiency of innovation activities in the forestry industry mainly depends on innovation expenditure (Diaz-Balteiro et al., 2006). Yan Hui pointed out that China should vigorously strengthen the ability of independent design and manufacture of advanced equipment and instruments to improve the original innovative capacities (Yan & Others, 2007).

(3) Cultural Environment; Innovation needs an excellent cultural atmosphere. Innovation requires a favorable organizational environment and a good internal innovation environment. Yu Zhi-wei, Zhou Guo-hong, and Wang Bin studied the cultivation of an innovation environment under a fuzzy network. They believed cultivating an innovative environment and atmosphere played an important role in realizing innovation. They also put forward some suggestions for cultivating an innovative environment(Yu et al., 2011). Cheng Yinghong and Manning Patrick believe that the main obstacle to the emergence of primitive innovation in China is the lack of a social and cultural environment to encourage innovation, which mainly includes the political environment, the government's policy environment, and the academic environment for free academic discussion, which leads to the lack of truth-seeking and questioning spirit of social members, especially the original and innovative spirit of daring to break through (Cheng & Manning, 2003). Brown Philip, H Park, and Albert believe that the poverty and weakness of original innovation in China are related to education (Brown & Park, 2002). Mulford Billi pointed out the relationship between excellent academic leaders, a good academic environment, an intense learning atmosphere, effective incentive mechanisms, and original innovation(Mulford, 2003). Yu Wen, He Haibo, and Zhang Nian use the DEA method to analyze the utilization rate of the innovation environment in different regions, and the study shows that the medium and low regional innovation efficiency is mainly caused by the low utilization rate of innovation input resources (Yu et al., 2009). Wallach believes that innovative culture usually refers to the fact that employees with entrepreneurial spirit or ambition are more likely to succeed because of the complex, competitive environment in which enterprises

are located and the creative and unpredictable risks in their work tasks, thus forming a culture that attaches importance to the courage of members to face challenges and innovation and respects individual personality characteristics. A culture that supports employee risk-taking(Wallach, 1983). Cameron believes that innovative culture refers to the organizational culture that is very extroverted, undertaking various risks that enterprises are unfamiliar with and accepting significant innovations. At the same time, the organization's working environment is also quite open, attaching great importance to the innovation and challenge of employees. The organization also has a high degree of support and trust, respecting the unique personal characteristics of employees. It belongs to an open and flexible corporate culture (Cameron, 1995). Jassawalla and Sashitta define a pro-innovation culture as a social and cognitive environment of shared and sustained collective beliefs and value systems about reality reflected in participants (Jassawalla & Sashittal, 2002).

(4) Team Aspect; Abbe and Dickson studied the working climate of R & D teams in the semiconductor industry. They found that team climate, characteristics, and member relationships affect employees' creativity (Abbey & Dickson, 1983). Ballard believes that the innovation climate can effectively predict the work team's innovation behavior and performance (Bharadwaj & Menon, 2000). Jiao Jian-ling, Zhang Xiao-lan, and Tang Yun-shu pointed out in their research that the construction of an enterprise's original technology innovation team is the key to enterprise innovative capacities, the construction of the core person is the key to the management of the enterprise's original technology innovation team, the reasonable combination of innovation team and the consistent action program give team coordination and continuous incentive; To create a suitable environment for the original technology innovation team of enterprises, so that the actual technology innovation activities of enterprises can obtain more innovative results (Jiao et al., 2020). Ren Feifei and Zhang Jinghuan found that the supportive climate of work teams is positively related to employees' innovative behavior(Ren & Zhang, 2015). Hirst Giles found that team learning behavior significantly moderates the relationship between learning orientation and employee creativity(Hirst et al., 2018). The

support of team members can enhance the creativity of employees. Oldham and Cummings point out that employee interaction can stimulate employee creativity, and employee creativity will be improved if there is healthy competition among colleagues(Oldham & Cummings, 1996). Zhou and George's research shows that the higher the level of support from colleagues, the higher the creativity of employees(George & Zhou, 2007). Some studies have pointed out that good team communication can promote the establishment of a trusting relationship between individual and team leader, between individual and team members, between members and members, alleviate destructive conflicts, promote the development of shared mental models, improve organizational commitment, team performance, and achieve win-win effect between team and members ((Jo & Shim, 2005).In short, team communication is a positive experience of information sharing and communication. Based on the above literature, combined with the focus of this study and the specific situation of Chinese universities, this study will focus on organizational climate, innovation incentives, career development, and team building to analyze the factors affecting the innovative capacities of Chinese universities data science professionals.

2.4.2.3 Family Factors; Today, with the accelerating pace of life, employees face double pressures from organizations and families. There are two main views on the relationship between work and family: work-family conflict theory and work-family promotion theory.

(1) Work-Family Conflict Theory; Rau Barbara L believes role conflict will occur when individuals can not meet the needs of multiple roles simultaneously between work and family(Rau & Hyland, 2002). Frone MR and Yardley JK point out that conflict occurs when the demands placed on an individual in one domain limit his ability in another domain so that he cannot perform the necessary tasks in another domain(Frone et al., 1997). Individuals have multiple roles, and when individuals have to satisfy one area because of pressure, they do not have sufficient resources or ability to satisfy another. According to Safrizal Helmi Buyung Aulia, work-family conflict refers to the role conflict caused by the dual pressures from both work and family, which is difficult to reconcile in some aspects (Safrizal et al., 2020). It includes three specific forms of conflict: the time-based work-family conflict, the spirit-based work-family conflict, and

the behavior-based work-family conflict. Cleveland & Ellis found that regular working hours mainly cause stress. Irregular working hours cause women to be unable to arrange their work and rest time reasonably, leading to passive acceptance of working time arrangements, resulting in a lack of active understanding of their roles, resulting in role ambiguity and inner conflict (Cleveland & Ellis, 2015).

(2) Work-Family Promotion Theory; Based on many studies, Katz and Kahn put forward the Role Reinforcement Hypothesis; they believe an individual has multiple roles simultaneously he is the father of two children and an ordinary employee of an enterprise simultaneously. The multiple roles of an individual can promote each other(Katz & Kahn, 1978). For example, the transfer and utilization of acquired knowledge and skills and the transfer and utilization of acquired positive emotional support. Some scholars represented by Frone began to explore the positive interaction between work and family. Work-Family Enrichment Study, Work-Family Improvement Study, and Work-Family Positive Spillover Study (Cooper et al., 1992). Greenhaus and Powell put forward the study of work-family facilitation based on summarizing previous studies; that is, WFF refers to individuals who can harvest some resources from a field work or family, such as experience, skills, opportunities, etc. These resources can improve the performance of individuals in another area family or work (Marcinelli, 1997). Thus, the more abundant the resources available to a family, the more conducive to the healthy development of the family and its members. Ilies Remus summarized the current situation of work-family facilitation research and believed that the concept of work-family facilitation was put forward, and in the past, the research on work-family interface mainly focused on the study of work-family conflict; that is, scholars believed that the negative spillover of work-family domain led to the occurrence of conflict (Ilies et al., 2009).

To sum up, we can find the extent to which individuals contribute to developing one social system work or family because of their investment in another system family or work. Work and family are two important social subsystems. Promotion is also a two-way process; on the one hand, investment in work contributes to the development of family life work-family promotion; Correspondingly, investment in family life also contributes to the development of work family-work promotion.

If we want to make employees more comfortable to work, we must pay attention to the important role of the family in employees' innovative capacities. In real life, it is easy to find that employees can get support from their organizations that is conducive to family life and help from their own families that is conducive to their work.

2.4.3 Summary of Influencing Factors of Data Science Professionals' innovative capacities; to sum up, the factors affecting data science professionals' innovative capacities mainly include individual, organizational, and family factors. Each dimension also contains several analysis points, according to which the specific content of the factors affecting the innovative capacities of data science professionals is obtained, as shown in Table 2.5. It will be the basis of designing the semi-structured interview questionnaire of the factors affecting data science professionals' innovative abilities.

Table 2.5 Influencing Factors of Data Science Professionals' Innovative Capacities

	individual factors	innovative thinking
Factors Affecting data science professionals' innovative capacities		Innovative personality
		innovation knowledge
	organizational factors	Innovation atmosphere
		innovation incentive
		Career Development
		Team building
	Family Factors	family atmosphere
		job support

Source: Developed by the author of this Study

2.5 Evaluation Index of Data Science Professionals' Innovative Capacities

In China, some scholars have theoretically constructed and elaborated on the composition, current situation, and reasons for data science professionals' innovative capacities from the perspectives of universities' functions and the data science professionals' tasks (Juanjuan, 2014). Some scholars have carried out detailed theoretical analyses on how to cultivate and enhance the innovative capacities of data science professionals, especially the teaching innovative capacities. Dai Jun and Zhang Lifen pointed out that based on the knowledge management theory and the functions of universities, data science professionals' innovation capabilities mainly include teaching innovation capabilities, scientific research innovation capabilities, social service

innovation capabilities, and cultural heritage innovation capabilities (Jun & Lifen, 2014). Chen Kaiyan suggested improving the innovative capacities of data science professionals from various aspects, such as cultivating innovation consciousness, improving knowledge structure, strengthening the construction of teaching staff, and reforming the management system (Kaiyan, 2007). Yang Yuhao and Su Xiongwu conducted an empirical study on the innovative capacities of data science professionals in Guangdong Province, pointing out that the innovative capacities of data science professionals is composed of four dimensions: knowledge accumulation, awareness of change, innovation atmosphere, and balance, and from scientific research and teaching training, knowledge accumulation, Atmosphere creation, moral education, and psychological counseling have proposed ways to improve data science professionals' innovative capacities (Yang & Su, 2014). Zhou Jianzhong and Liang Minghui designed an evaluation index system that affects the innovative capacities of data science professionals through empirical research on data science professionals in the three northeastern provinces of China (Zhou & Liang, 2016).

Based on the research results of the scholars mentioned above, combined with the research and analysis done by the author, an index system for evaluating the innovative capacities of data science professionals is designed, as shown in Table 2.6. The indicator system is divided into four first-level indicators: intrinsic innovation characteristics, teaching, and scientific research innovation literacy, teaching performance innovation, and scientific research performance innovation. Below each first-level indicator, there are multiple second-level indicators.

Table 2.6 Index System for Evaluating the Innovative Capacities of Data Science Professionals

Index System of data science professionals' innovative capacities	Teaching innovation	1)Innovation can enhance the teaching experience through technology integration 2)Innovation can enrich active learning strategies 3)Innovation can perfect the flipped classroom model 4)Innovation can boost project-based learning 5)Innovation can boost inclusive teaching practices 6)Innovation facilitates personalized learning paths

	Technological innovation	1)Scientific research can lead to the identification of new phenomena, processes, or relationships 2)Innovation can deposit discoveries and reveal new phenomena 3)Innovation can drive technological progress 4)Innovation can drive improvements in research methods 5)Beds can boost tech commercialization 6)Innovation can facilitate paradigm shifts 7)Innovation can foster interdisciplinary collaboration
	social service innovation	1)Innovation can facilitate community-engaged research that addresses specific needs and challenges 2)Innovation can boost social entrepreneurship Projects 3)Innovation can make better service-learning programs 4)Innovation can promote the development of innovation centers and incubators 5)Innovation can advance policy research and advocacy 6)Innovation can enhance capacity building and training 7)Innovative technology can benefit society

CHAPTER 3
RESEARCH METHODOLOGY

The research objectives of this chapter are as follows: (1) using the Delphi technique to identify the determinants of Chinese data science professionals' innovative capacities; (2) Using the questionnaire survey method, the results of the Delphi technique were investigated, and the reliability and validity of the survey results were tested by SPSS software to ensure the authenticity and effectiveness of the survey results. This chapter describes the methodology used to collect the data using the Delphi technique. The study used quantitative and qualitative research methods and sought expert opinion through four rounds to draw scientific conclusions; At the same time, this chapter also uses SPSS 28.0 software to explain the research tools of data collection, data collection procedures, and statistical methods used in data analysis. It introduces the situation of using AMOS software to model the data results. The research instruments used for data collection, the data collection procedures, and the statistical methods used for data analysis are explained below:

3.1 Theoretical Framework

3.2 Sampling Techniques

3.3 Instrumentation

3.4 Data Collection Procedures

3.5 Statistical Analysis

3.1 Theoretical Framework

The theoretical framework of this study is based on several key concepts and theories. The first concept is innovation, which refers to creating new ideas, products, or services that add value to society (Klofsten et al., 2019). Innovation is a crucial driver of economic growth and development, and universities must foster a culture of innovation among their faculty. The second concept is creativity, which is closely related to innovation. Creativity is the ability to generate original ideas and is a critical component of the innovation process (Sarooghi et al., 2015). Various factors influence creativity, including personal characteristics, organizational culture, and environmental factors. The

third concept is innovation diffusion, which refers to the process by which new ideas, products, or services are adopted and spread throughout society (Vargo et al., 2020). The diffusion of an innovation is influenced by several factors, including the characteristics of the innovation, the characteristics of the adopters, and the communication channels used to promote the innovation.

The theoretical framework of this study mainly involves several vital theories. The first theory is social learning theory (Bandura & Walters, 1977), which posits that individuals learn by observing and imitating the behavior of others. Social learning theory is relevant to this study because it suggests that the behavior of colleagues and peers may influence university faculty's ability to innovate. The second theory is innovation diffusion theory (Wani & Ali, 2015), which provides a framework for understanding how new ideas, products, or services are adopted and spread throughout society. The innovation diffusion theory is relevant to this study because it suggests that university faculty's adoption and diffusion of innovations may be influenced by various factors, including the innovation's characteristics, the adopters' characteristics, and the communication channels used to promote it. The third theory is organizational culture theory (Hatch & Zilber, 2012), which argues that an organization's culture can influence the behavior of its members. Organizational culture is relevant to this study because it shows that university culture can affect faculty innovation.

Based on these concepts and theories, this study's theoretical framework proposes that data science professionals' innovative capacities are influenced by various factors such as individual characteristics, organizational culture, and environmental factors.

3.2 Sampling Techniques

Developed by the Rand Corporation in the 1950s, the Delphi method is a structured, interactive research program designed to gain the insights of a single group of experts on a particular topic (Pill, 1971).

3.2.1 Selection of Experts; the experts were selected by purposive sampling. In a purposive sampling strategy, participants are selected because they can purposively inform the central phenomenon in the study (Creswell & Creswell, 2009). Rather than collecting standardized information from a large and statistically significant sample

(Patton, 2002), Patton points out that. Collecting information and focusing on a small number of carefully selected participants is better. Therefore, according to the needs of this study, the experts of this study are composed of experts from China, including professors from universities, experts from administrative departments, etc. All experts have qualifications in higher education management, have doctoral degrees, have worked for more than five years, and have served as assistant professors at least. These have a more in-depth understanding and research on the innovative capacities of Chinese data science professionals.

3.2.2 Number of Experts; According to Bryman, the criterion for sample size is the size required to reach saturation (Bryman, 2012). Under normal circumstances, expert groups usually consist of 10 to 30 experts (Worrell et al., 2013). However, no significant relationship between group size and decision effectiveness has been found (Brockhoff, 1975), and it is unlikely that another group of the same experts would produce a completely different result from a group of 15 experts (Martino, 1985). The saturation criterion determines the number of respondents in this study, so this study selected 17 experts as respondents. All participants were invited individually, and participants needed to learn from each other to ensure that more objective data could be obtained in the participation process (Benbasat et al., 1987). The list of experts is detailed in Appendix A. There are two forms of interviews, face-to-face and telephone.

3.3 Instrumentation

3.3.1 The First Stage: The Analysis Process of Determining the Influencing Factors of Data Science Professionals' Innovative Capacities by Using the Delphi Technique

3.3.1.1 Questionnaire Interviewees; Because this research needs to expand the coverage of the interviewees, improve the width and breadth, and ensure the effectiveness of data collection, the questionnaire survey method is selected. In the pre-research stage, the original items of the Questionnaire were formed by an open questionnaire combined with interviews, and 120 interviewees were selected, including data science professionals, administrators, students, business managers, etc. The topic was What factors do you think affect the innovative capacities of data science professionals? The respondents were asked to write item by item until no more items were added.

Investigators will summarize all the items collected, merge the same items, and give feedback to all the respondents to ensure that their items are covered.

      3.3.1.2 Semi-structured Interview; This study adopts the form of a semi-structured interview (Adeoye-Olatunde & Olenik, 2021). An informal interview was conducted according to a thick-lined interview outline. This method has only a rough essential requirement for the conditions of the interviewees and the questions to be asked. Interviewers can make necessary adjustments flexibly according to the actual situation of the interview. As for the way and order of questions, the way of answers of interviewees, the way of interview records, and the time and place of interviews, there are no specific requirements, and the interviewers can deal with them flexibly according to the situation.

      1) The Purpose of Using Semi-structured Interviews; The primary purpose is to deeply understand the participants' understanding and preliminary judgment of the influencing factors of data science professionals' innovative capacities. According to Matthews & Ross, having a clear and flexible set of interview questions helps gain a better understanding or create natural and informative conversations (Matthews & Ross, 2010). The researcher conducted two types of interviews: telephone interviews and face-to-face interviews.

      2) Telephone Interview Method; It is mainly suitable for the situation where the participants are scattered, and the interviewers are challenging to interview face to face. They are a form of data collection in which investigators communicate with respondents by telephone based on prepared questionnaires. In this study, because some interviewees are located in different cities in Sichuan Province, China, it is not convenient for all the interviewees to communicate face to face, so telephone and face-to-face interviews are used. Creswell describes telephone interviews as collecting data and asking a few general questions using the telephone, which is short and focused on gathering information. In the study, participants were asked to comment before being interviewed, and the entire conversation was recorded to ensure she got all the interviews (Creswell, 2012).

      3) Interview Method; According to the requirements of the sampling plan, the investigator goes to the selected family or unit, selects the appropriate interviewees

according to the pre-specified method, and then conducts direct face-to-face interviews according to the questionnaire or survey outline. This approach ensures the quality of the data obtained. An interview is easy to establish trust and cooperation between interviewees and interviewees, and it is expected to get higher quality samples and more content, more profound questions, and higher quality data; it also has an incentive effect. In this study, the researchers asked questions to one participant at a time and recorded their responses (Denscombe, 2007). A total of 17 participants in the study adopted this form.

    4) The Main Content of the Semi-structured Interview; The first round of this study used the semi-structured interview (Patton, 1990) to brainstorm the factors related to the innovative capacities of data science professionals. See 4.1.1 for the content of the semi-structured interview.

  3.3.1.3 Questionnaire I; In the second round, Questionnaire I evaluates the experts' opinions on the influencing factors of data science professionals' innovative capacities. It used content validity to synthesize data from semi-structured interviews to construct a questionnaire I (Appendix C). Questionnaire I is the evaluation of 17 experts, involving the analysis of the influencing factors of data science professionals' innovative capacities. In order to improve the accuracy and comprehensiveness of the study, a questionnaire was developed. The purpose of these data is to analyze the influencing factors of data science professionals' innovative capacities from the perspective of scholars. According to Gray (Harms et al., 2014), questionnaires are ideal when the audience is relatively large, and a descriptive approach to standardized questions is required. The star rating was chosen because it makes it easy to distribute the Questionnaire and ensures the confidentiality of the participants. The study used a five-point Likert scale (Likert, 1932), as shown below. The Questionnaire is based on the questionnaire star rating, using the Likert five-point scale format. The survey results of Questionnaire I are shown in Table 4.1-4.3.

1 = strongly disagree

2 = disagree

3 = neutral

4 = moderately agree

5 = strongly agree

3.3.1.4 Questionnaire II : After Questionnaire I had been returned, the responses were synthesized and developed through a diagram chart and then categorized into: similarities and differences. Questionnaire II (Appendix D) used a five-point Likert scale(Verhagen et al., 1998) (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = moderately agree, 5 = strongly agree) as shown in Appendix D., It was sent to the experts for the third round. The survey results of Questionnaire II are shown in Table 4.4-4.6.

3.3.1.5 Questionnaire III: After Questionnaire II had been returned, the responses were identified, categorized, and condensed into significant themes and suggestions and sent back to all experts for review and consensus for the fourth round. Questionnaire III (Appendix E) was used to check the content validity by 17 experts based on 'yes' or 'no' and 'unsure.' The results of Questionnaire III are shown in Tables 4.7-4.9.

3.3.2 The Second Stage: Analysis and Verification of the Results of the Delphi Technique; in this stage, the questionnaire survey method will be used to conduct extensive research on the results of Delphi technology and to analyze the credibility and validity of the research results. The reliability and validity analysis used SPSS software (Verma, 2012).

3.3.2.1 Survey Participants; The study participants comprised 400 data science professionals selected by simple random sampling from 23 Sichuan Province, China, public universities.

3.3.2.2 Instruments; After questionnaire III is returned, according to expert advice, the expert advice is converted into questionnaire IV (Appendix F). Questionnaire IV adopts the method of a five-level Likert scale, with "individual factors," "organizational factors," and "family factors" that affect the innovative capacities of Chinese data science professionals produced by Delphi technology as independent variables and "innovative capacities of data science professionals" " is the dependent

variable specifically, "teaching innovation," "scientific research innovation" and "service social innovation" established in Table 2.6.

3.3.2.3 Data Collection; This survey is used to improve further the influencing factors of data science professionals' innovative capacities proposed by Delphi technology. The basic process is as follows:

1) The researchers contacted/contacted/called 23 universities in Sichuan, China, and selected 400 data science professionals using simple random sampling.

2) The researcher sends the Questionnaire to the respondent's "questionnaire star," requiring all the respondents to return the Questionnaire within the specified time.

3) Analyze the returned survey questionnaires.

3.3.2.4 Statistical Analysis: The Researchers Analyzed the Returned Questionnaires

1) Analyze the basic situation of the sample population of the survey questionnaire. Only when the sample data meet the research requirements the research is authentic and reliable.

2) Use SPSS software to analyze the credibility of the survey results only when Cronbach's $\alpha > 0.7$. The Questionnaire has high reliability and is suitable for further analysis.

3) Use SPSS software to analyze the effectiveness of the survey results. Since most of the survey questionnaire options in this study were created by the researchers, exploratory factor analysis was performed first. , in line with the expected division dimension, it shows that the survey questionnaire has high structural validity and is suitable for further analysis. On this basis, the researchers also conducted a confirmatory factor analysis.

3.3.3 Create a Model of Factors Affecting the innovative capacities of Data Science Professionals' in China; based on the reliability and validity analysis using SPSS, the analysis results are simulated using AMOS 21.0 software (Barnidge & De Z U N Iga, 2017) to create a model of factors affecting the innovative capacities of Chinese data science professionals (Figure 5.3).

3.4 Data Collection

The Delphi method was used to collect data.

3.4.1 Round 1: In the brainstorming session, the researchers focused on the factors that affect the innovative capacities of data science professionals, and the results were used in the framework of semi-structured interviews. The questionnaires were sent to a panel of 17 experts, who were given two to two and a half weeks to complete and return the first round of questions. After receiving the replies, the answers are classified and synthesized to form another questionnaire (Questionnaire I, as in Appendix C).

The first round of data collection was conducted as follows:

1)The researchers contacted/contacted/called 17 qualified experts and requested their consent to participate in the study using the Delphi technique.

2)Appointments were made with all qualified specialists at the preferred date and time.

3) Questionnaires were given to all experts at the time of appointment and returned to the investigator.

4) The researchers divided the responses into similar and different categories to obtain a majority opinion.

5) The interview data of the semi-structured Questionnaire are grouped and arranged, and the first Questionnaire on the influencing factors of data science professionals' innovative capacities is drafted, focusing on the individual factors, organizational factors, and family factors that affect data science professionals' innovative capacities. The researchers who prepared the Questionnaire followed Likert's five-point scale—frequency and percentage of data used for analysis. Sections of the five scales were analyzed using mean (M), standard deviation (SD), and correlation. The respondents' agreement was as follows: an average score of 1.00-1.49 indicated strong disagreement, and an average score of 4.50-5.00 indicated strong agreement.

3.4.2 Round 2: This is an assessment of the expert's ideas phase, using the Likert five-point scale to assess expert responses. In the second round of evaluation, a questionnaire was used to measure management experts' impact on data science professionals' innovative capacities.

1) The investigator contacted/contacted/called 17 qualified experts to request their consent to participate in the study using the Delphi technique.

2) Appointments were made with all qualified specialists at the preferred date and time.

3) Give the Questionnaire to all experts at the time of the appointment and return it to the investigator.

4) The researchers divided the responses into similar and different categories to obtain a majority opinion.

5) The researchers then processed the new data from the first round of open-ended questionnaires to check for consensus. The researchers selected these items from the results of a semi-structured interview questionnaire.

6) The data of 17 experts were collected by mail or interview.

7) Measure each question item's median, mode, and interquartile values.

8) The data about the factors affecting the innovative capacities of data science professionals. After that, according to experts' data, the researcher revised the Questionnaire to get Questionnaire II.

3.4.3 Round 3: re-evaluation: In this re-evaluation stage, the researcher selected the items from the questionnaire results and gathered the factors that affect the innovative capacities of data science professionals. Similarity means most 17 experts agree, while difference means the opposite. The combined results were used to develop Questionnaire II (using the Likert five-point scale), sent to the third round of experts.

In the third round, 17 experts were asked to score Questionnaire II in a new round of the Likert scale.

1) Items are selected from the results of Questionnaire 2. It includes individual, school, and social policy factors that affect data science professionals' innovative capacities.

2) The results of the study were summarized as similarities or differences. Similarities mean most of the 17 experts agree, while differences mean the opposite. The combined results were used to develop Questionnaire III.

3) Appointments have been made with all qualified experts at the expert's preferred date and time.

4) Questionnaires were given to all experts at the time of appointment and returned to the investigator.

5) After completing Questionnaire III, the researchers determined the final results of the factors affecting the innovative capacities of data science professionals, which were used for expert discussion in the fourth chapter.

3.4.4 Round 4: Viable ideas have been identified, resolved, and reported in this round. Experts acknowledged the views, ideas, or strategies of the Group of Experts and the details of their implementation.

Solutions-Reports: In the fourth round, the experts identified feasible ideas, made resolutions, and made reports. In addition, the experts heard all the group's opinions, ideas or strategies, and implementation details.

3.5 Statistical Analysis

In this study, SPSS software and AMOS software were used for statistical analysis.

SPSS (Statistical et al.) is the earliest statistical analysis software in the world, and it is also the most widely used statistical analysis software. SPSS supports rich data sources, has powerful data access and management capabilities and programming capabilities, has complete data input, editing, statistical analysis, report, graphics production, and other functions, provides a complete data analysis process, and covers complete data statistical analysis Methods, such as exploratory analysis of data, partial correlation, analysis of variance, non-parametric testing, multiple regression, logistic regression, etc.(Bala, 2016) This study uses SPSS software and principal component analysis to analyze the credibility of the survey results and conducts exploratory factor analysis and confirmatory factor analysis to ensure the reliability and rationality of the survey results. The results of the SPSS software analysis are shown in Table 4.10-4.30. AMOS (Analysis of Moment Structures), an analysis software that deals with Structural Equation Modeling (SEM), is a very powerful statistical analysis software that can help us perform various data analyses, including structural equation modeling, factor analysis, multivariate linear regression and more(Collier, 2020). This study uses AMOS to build a model of the analysis results of SPSS (see figure 5.1,5.2), which provides a

basis for establishing a model of the factors influencing the innovative capacities of Chinese data science professionals in this study.

CHAPTER 4
RESEARCH RESULT

This chapter uses the Delphi technique to analyze the influencing factors of Chinese data science professionals' innovative capacities. To ensure the credibility of the results, the researcher conducted extensive research on the results of the Delphi technique by questionnaire survey and used SPSS software to perform reliability analysis, exploratory factor analysis, and confirmatory factor analysis to ensure the scientific and reasonable results.

    4.1 Descriptive Data Statistics

    4.2 Research and Statistical Analysis Results

    4.3 Summary

4.1 Descriptive Data Statistics

Round 1: Brainstorming: the first round collects the influence factors of data science professionals' innovative capacities. 83 opinions on individual factors, 48 organizational factors, and 27 family factors affecting data science professionals' innovative capacities were collected (Appendix B). Based on brainstorming, Questionnaire I (Appendix C) was formed.

Round 2: Evaluation of the Experts' Ideas. The second round of comprehensive evaluation of the factors affecting the innovative capacities of data science professionals in China. It was assessed using the Likert five-point scale. The Questionnaire is mainly composed of four parts: the name of the study, the preface, the main body of the question, and the column of amendments. Experts need to assign corresponding scores of 5, 4, 3, 2, 1 (5 = strongly agree, 4 = agree, 3 = Neutral, 2 = disagree, 1 = strongly disagree) to the indicators of the central part of the problem according to the degree of importance, to collect the judgment data of experts on the importance of indicators at all levels and evaluation criteria in the study. If some experts think that an index is inaccurate, they can fill in the revised content in the revision item; If the validity of the index is not high, the deleted item can be selected directly to express deletion; If there are items that have not been considered, they can be added in the additional items column, and the added items

also need to be judged for their importance (the same method is used in the third round). The statistical results of Questionnaire I are shown in Tables 4-1 to 4-3.

Round 3: Re-Evaluation. After the second round of expert evaluation, experts suggested that two of the individual factors affecting data science professionals' innovative capacities should be deleted; Two of the organizational factors were revised and merged into one; The family factor will be added to one item. According to the experts' opinions, form Questionnaire II (Appendix D), send Questionnaire II to the experts, and get the reply. The expert opinions of the third round are shown in Tables 4-4 to 4-6.

Round 4: Resolved and Reported; after a third round of reassessment, Questionnaire III (Appendix E) was developed for expert evaluation. Through the assessment of experts, the factors affecting the innovative capacities of Chinese data science professionals are preliminarily drawn up.

4.1.1 Round 1: Brainstorming

4.1.1.1Individual Factors and Innovative Capacities

1)The Influence of Innovation Motivation on Innovation Capability (Le & Lei, 2019). For example, whether they have strong enthusiasm for research work; Like to solve the problems faced in work, think that doing research work to achieve results in the future can get more economic returns; Want to improve the teaching level through innovation; Awards, and grants for innovative work can enhance their reputation, career prospects, and promotion opportunities; and so on.

2)The Influence of Innovative Personality on Innovative Capacities (Othman, 2016) If there is a curiosity to explore new things; A solid will to conduct scientific research; Be open to new ideas and thinking outside the box; Not afraid of failure and setbacks as learning opportunities; Strong problem-solving orientation, good at identifying and analyzing challenges or problems; Demonstrates resilience and perseverance in the face of challenges and setbacks; and so on.

3)The Influence of Innovative Thinking on Innovative Capacities (Barak & Yuan, 2021) For example, we can find valuable and regular problems in general phenomena; Be good at associating and exerting imagination when thinking and solving problems; Adopt creative problem-solving techniques to address challenges and find

innovative solutions; To engage in critical thinking and analyze situations and information from multiple perspectives; Systematic thinking, seeking holistic and sustainable solutions; and so on.

4)The Influence of Innovation Knowledge on Innovative Capacities (Singh et al., 2021) Such as broad interdisciplinary knowledge, Rich professional theoretical knowledge, and frontier knowledge; Reviewing previous studies and identifying strengths and weaknesses; Innovative teaching methods and knowledge of teaching methods; Proficiency in design thinking methods and creative problem-solving skills; Proficient in research methods, data analysis, and evaluation techniques; and so on.

4.1.1.2 Organizational Factors and Innovative Capacities

1)The Influence of Organizational Climate on Innovative Capacities (Andersson et al., 2020) For example, organizations encourage learning, tolerate failure, encourage new ideas, encourage the implementation of new ideas, publicly praise innovators, and employees have innovative consciousness; Leaders have a strong sense of innovation, perseverance, courage to take innovative risks, insist on learning, support innovative activities, trust innovators, put forward suggestions for improvement, etc.

2)The Impact of Innovation Incentives on Innovative Capacities (Manso, 2017) Such as monetary incentives and increased benefits, Honor or praise, etc.

3)The Impact of Career Development on Innovative Capacities (Kettunen, 2021) Such as training opportunities, promotion opportunities, etc.

4)The Influence of Team Building on Innovative Capacities. (Johnsson, 2017)Such as clear objectives, feasible objectives, recognized objectives, clear assessment criteria, brainstorming of members, work, and objectives related, mutual supervision, overall recognition, resource sharing, encouragement, communication, mutual help, and so on.

4.1.1.3 Family Factors and Innovative Capacities

1)The Influence of The Family Atmosphere on Innovative Capacities (Chen & Huang, 2016)Such as family harmony and warmth, family understanding and support, family career-related, proper handling of contradictions, no promotion pressure, etc.

2)The Impact of Job Support on Innovative Capacities (Demircioglu, 2021) Such as expanding knowledge, putting forward useful suggestions, little economic pressure, providing social relations, independent working space, family undertaking housework, etc.

4.1.2 Round 2: Evaluation of the Experts' Ideas

4.1.2.1 Individual Factors; After sending the Questionnaire to the experts, the experts gave feedback. The following is a description of expert input from three aspects: individual factors, organizational factors, and family factors. Tables 4.1 to 4.3 are summaries of specialist feedback.

Table 4.1 Analysis of Individual Factors Affecting Data Science Professionals' Innovative Capacities (Questionnaire I)

	individual factors	M	Expert Opinion	SD	IQR	consensus
1. Innovative thinking	1) Able to see the multi-faceted aspects of the problem and think about the problem from multiple angles	4.71	Strongly agree	0.46	1	Congruence
	2) Like to seek different perspectives	4.65	Strongly agree	0.48	1	Congruence
	3) Explore and study the incredible connections between things	4.82	Strongly agree	0.38	1	Congruence
	4) have a rich imagination	4.47	Moderately agree	0.7	1	Congruence
	5) Be willing to make problem assumptions and seize opportunities for change	4.53	Strongly agree	0.61	1	Congruence
	6) Connect seemingly unrelated concepts, theories, or areas of knowledge	3.06	Neutral	1.26	2	In-congruence
	7) Willingness to try new ideas and approaches	4.65	Strongly agree	0.59	1	Congruence
	8) Curiosity, desire to explore and learn	4.71	Strongly agree	0.46	1	Congruence

		M		SD	IQR	
2. Innovative personality	9) Be creative, open to new ideas, and think outside the box	4.29	Moderately agree	0.89	1	Congruence
	10) The approach of data science professionals is adaptable and flexible	2.82	Neutral	1.34	2	In-congruence
	11) Dare to take risks and not be afraid of failure	4.47	Moderately agree	0.78	1	Congruence
	12) Resilience, showing perseverance in the face of challenges and setbacks	4.65	Strongly agree	0.59	1	Congruence
3. Innovation knowledge	13) Have rich subject expertise to lay the foundation for innovation	4.59	Strongly agree	0.69	1	Congruence
	14) Willingness to learn about the latest research results, emerging trends, and developments in the research field	4.76	Strongly agree	0.42	1	Congruence
	15) Have an interdisciplinary perspective and be able to integrate different perspectives to promote innovation	4.82	Strongly agree	0.38	1	Congruence
	16) Proficiency in research methods, data analysis, and evaluation techniques	4.71	Strongly agree	0.67	1	Congruence

Note: M= Mean (1.00 – 1.49 = Strongly disagree; 1.50 – 2.49 = Disagree; 2.50 – 3.49 = Neutral; 3.50 – 4.49 = Moderately agree; 4.50 – 5.00 = Strongly agree); SD = Standard Deviation; IQR = Interquartile Range (IQR< 0.50 ≥ 1.00 = Congruent; IQR>1.00 = Incongruent)

From Table 4.1, we can see that among the individual factors affecting the innovative capacities of data science professionals, they strongly agree with "being able to see the multi-faceted aspects of the problem," thinking from multiple perspectives," liking to seek different points of view" exploring the incredible connection between things"willing to make assumptions about the problem" grasp the opportunity to change

and willing to try new ideas and ways" The desire to explore and learn" Be creative、 accept new ideas、 think out of the box" be resilient show perseverance in the face of challenges and setbacks" have rich disciplinary expertise" lay the foundation for innovation" be willing to understand the latest research results" emerging trends and development in the field of research and have an interdisciplinary perspective" ability to integrate different perspectives to promote innovation" Proficiency in research methods, data analysis, and evaluation techniques."They agreed on the options of "having rich imagination and daring to take risks and not afraid of failure" and "basically reached agreement," The average value of the above indicators is above 4.0, indicating that the importance of all indicators is above the general level. The average value of the above indicators is above 4.0, meaning that the importance of all indicators is above the general level. The standard deviations of all evaluation indexes are between 0 ~1, <1. The opinions of experts on the evaluation index are relatively concentrated. For the option of "linking seemingly unrelated concepts, theories or knowledge areas," the opinions of experts are quite different, with an average of 3.06 and a dispersion of 1.26 (> 1). After consulting experts, some experts believe that linking knowledge in different fields will help to develop innovative thinking, which is conducive to the improvement of data science professionals' innovative capacities; Some experts believe that data science professionals should focus on the development of their research fields, if the research fields are too scattered, it will not be conducive to the innovation of data science professionals. For the option of "data science professionals' methods are adaptable and flexible," experts' opinions are also quite different, with an average score of 2.82 and a discrete value of 1.34, indicating that experts' opinions are not uniform enough. Some experts believe that adaptability and flexibility are part of innovative capacities itself and should not be an option. Combining expert opinions and the content of this study, these two opinions of experts will be adopted, and these two options will be deleted in the next round of consultation.

4.1.2.2 Organizational Factors

Table 4.2 Analysis of Organizational Factors Affecting Data Science Professionals' Innovative Ability (Questionnaire I)

	organizational factors	M	Expert Opinion	SD	IQR	consensus
1. Organizational atmosphere	1) The school encourages data science professionals to learn actively	4.59	Strongly agree	0.49	1	Congruence
	2) Schools tolerate teacher failure	4.65	Strongly agree	0.68	1	Congruence
	3) The school encourages data science professionals to come up with new ideas	4.59	Strongly agree	0.69	1	Congruence
	4) Schools encourage data science professionals to implement new perspectives	4.59	Strongly agree	0.6	1	Congruence
	5) The school publicly praises innovators who have achieved innovative results	4.53	Strongly agree	0.61	1	Congruence
	6) School leaders have a strong sense of innovation	4.00	Moderately agree	0.77	1	Congruence
	7) School leaders dare to take innovative risks	4.65	Strongly agree	0.68	1	Congruence
2. Incentives for innovation	8) Schools give innovators monetary rewards and benefits	4.24	Moderately agree	0.94	1	Congruence
	9) The school honors or commends innovators	4.12	Moderately agree	0.68	1	Congruence
3. Career Development	10) Schools provide more training	4.53	Strongly agree	0.78	1	Congruence

	opportunities for innovators					
	11) Schools give innovators more opportunities to advance	4.71	Strongly agree	0.57	1	Congruence
4. Team building	12) data science professionals have clear unity goals and clear assessment standards	4.71	Strongly agree	0.67	1	Congruence
	13) The members of the team brainstorm, work, and goals are related	4.65	Strongly agree	0.48	1	Congruence
	14) Team members supervise each other and agree with each other	4.41	Moderately agree	0.69	1	Congruence
	15) Team members share resources and encourage each other	4.41	Moderately agree	0.77	1	Congruence

From Table 4.2, experts' opinions are relatively unified, at least moderately agree. The school encourages data science professionals to learn "Schools tolerate teacher failure actively," The school encourages data science professionals to come up with new ideas," Schools encourage data science professionals to implement new perspectives," The school publicly praises innovators who have achieved innovative results" School leaders dare to take innovative risks" Schools provide more training opportunities for innovators" Schools give innovators more opportunities to advance"data science professionals have clear unity goals and clear assessment standards" The members of the team brainstorm, work and goals are related," The average score is above 4.5, reaching" strong agreement." "School leaders have a strong sense of innovation" Schools give innovators monetary rewards and benefits" The school honors or commends innovators" Team members supervise each other and agree with each other" Team members share resources and encourage each other，" The average score is above 4.0, indicating that the importance of all indicators is above the general level. From the discrete degree, the standard deviations of all evaluation indexes are

between 0 ~ 1 and < 1, indicating that experts' opinions on the evaluation index are relatively concentrated, and the degree of coordination of experts' internal opinions is relatively high. In the revision column, several experts mentioned that "the options schools encourage data science professionals to put forward new ideas" and "schools encourage data science professionals to implement new ideas" are closely linked; there is no need to separate the two; you can integrate the two options. Combining with the content of this study, we will adopt expert opinions and conduct the next round of consultation.

4.1.2.3 Family Factors

Table 4-3 Analysis of Family Factors Affecting Data Science Professionals' Innovative Capacities (Questionnaire I)

	Family factors	M	Expert Opinion	SD	IQR	Consensus
1. Family atmosphere	1) The family atmosphere is harmonious, and life is warm	4.53	Strongly agree	0.61	1	Congruence
	2) The family's financial pressure is not great	4.29	Moderately agree	0.89	1	Congruence
	3) Family members understand work and give more support for housework	4.47	Moderately agree	0.70	1	Congruence
2. Job support	4) Family members can handle various conflicts better	4.53	Strongly agree	0.61	1	Congruence
	5) When encountering work difficulties, family members can give reasonable suggestions	4.59	Strongly agree	0.6	1	Congruence
	6) Family members do not put pressure on job titles and job development	4.06	Moderately agree	0.73	1	Congruence
	7) Family members can use social relationships to provide work help for themselves	4.59	Strongly agree	0.69	1	Congruence

From Table 4.3, experts have concentrated opinions on family factors affecting data science professionals' innovative capacities. The family atmosphere is harmonious,

and the life is warm" Family members can handle various conflicts better" When encountering work difficulties, family members can give reasonable suggestions" Family members can use social relationships to provide work help for themselves," The average score of the options is above 4.5 points."The family's financial pressure is not great" Family members understand work and give more support for housework." Family members do not put pressure on job titles and job development," The average value is above 4.0 points, which shows that the expert opinions are relatively unified. The importance of all indicators is above the general level. From the discrete degree, the standard deviations of all evaluation indexes are between $0 \sim 1$ and < 1, indicating that experts' opinions on the evaluation index are relatively concentrated. At the same time, in the expert opinion column, some experts suggest that conflicts often occur between family and work. Suppose family members can give data science professionals relatively independent working space and do not interfere with data science professionals' work. In that case, the pressure on data science professionals will be relatively small, which is more conducive to improving data science professionals' innovative abilities. Therefore, it is suggested to add an option: family members should be given relatively independent working space. In addition to the subject of this study, the expert's opinion will be adopted as the option for the next round of consultation.

4.1.3 Round 3: Re-Evaluation; After the end of the second round of expert consultation, by analyzing the judgment data of experts and collecting and sorting out the modification opinions, the index items at all levels in the evaluation index system are adjusted to form the second round of expert consultation questionnaire II (see Appendix D for details). To make the experts familiar with this study, revise the index system again, and the selected experts are consistent with the first round of consultation experts, which can also ensure the scientific and rigorous process of building the evaluation index system.

Refer to Table 4.4 to Table 4.6 for feedback from experts in Questionnaire II.

Table 4.4 Analysis of Individual Factors Affecting Data Science Professionals'
Innovative Capacities (Questionnaire II)

	Individual factors	M	Expert Opinion	SD	IQR	Consensus
1. Innovative thinking	1) Able to see the multi-faceted aspects of the problem and think about the problem from multiple angles	4.82	Strongly agree	0.38	1	Congruence
	2) Like to seek different perspectives	4.94	Strongly agree	0.24	1	Congruence
	3) Explore and study the incredible connections between things	4.88	Strongly agree	0.32	1	Congruence
	4) have a rich imagination	4.76	Strongly agree	0.42	1	Congruence
	5) Be willing to make problem assumptions and seize opportunities for change	4.76	Strongly agree	0.42	1	Congruence
	6) Willingness to try new ideas and approaches	4.88	Strongly agree	0.32	1	Congruence
2. Innovative personality	7) Curiosity, desire to explore and learn	4.88	Strongly agree	0.32	1	Congruence
	8) Be creative, open to new ideas, and think outside the box	4.82	Strongly agree	0.38	1	Congruence
	9) Dare to take risks and not be afraid of failure	4.82	Strongly agree	0.38	1	Congruence
	10) Resilience, showing perseverance in the face of challenges and setbacks	4.76	Strongly agree	0.42	1	Congruence
3. Innovation knowledge	11) Have rich subject expertise to lay the foundation for innovation	4.76	Strongly agree	0.42	1	Congruence
	12) Willingness to learn about the latest research results, emerging trends, and developments in the research field	4.82	Strongly agree	0.38	1	Congruence
	13) Have an interdisciplinary perspective and be able to integrate different perspectives to promote innovation	4.88	Strongly agree	0.32	1	Congruence
	14) Proficiency in research methods, data analysis, and evaluation techniques	4.76	Strongly agree	0.55	1	Congruence

Table 4.5 Analysis of Organizational Factors Affecting Data Science Professionals' Innovative Capacities (Questionnaire II)

	Organizational factors	M	Expert Opinion	SD	IQR	consensus
1. Organizational atmosphere	1) The school encourages data science professionals to learn actively	4.82	Strongly agree	0.38	1	Congruence
	2) Schools tolerate teacher failure	4.82	Strongly agree	0.38	1	Congruence
	3) Explore and study the incredible connections between things	4.76	Strongly agree	0.42	1	Congruence
	4) The school publicly praises innovators who have achieved innovative results	4.88	Strongly agree	0.32	1	Congruence
	5) School leaders have a strong sense of innovation	4.59	Strongly agree	0.49	1	Congruence
	6) School leaders dare to take innovative risks	4.88	Strongly agree	0.32	1	Congruence
2. Incentives for innovation	7) Schools give innovators monetary rewards and benefits	4.82	Strongly agree	0.38	1	Congruence
	8) The school honors or commends innovators	4.59	Strongly agree	0.49	1	Congruence
3. Career Development	9) Schools provide more training opportunities for innovators	4.76	Strongly agree	0.42	1	Congruence
	10) Schools give innovators more opportunities to advance	4.88	Strongly agree	0.32	1	Congruence
4. Team building	11) data science professionals have clear unity goals and clear assessment standards	4.94	Strongly agree	0.24	1	Congruence
	12) The members of the team brainstorm, work, and goals are related	4.76	Strongly agree	0.42	1	Congruence

		4.59	Strongly agree	0.49	1	Congruence
	13) Team members supervise each other and agree with each other	4.59	Strongly agree	0.49	1	Congruence
	14) Team members share resources and encourage each other	4.71	Strongly agree	0.46	1	Congruence

Table 4.6 Analysis of Family Factors Affecting Data Science Professionals' Innovative Capacities (Questionnaire II)

	Family factors	M	Expert Opinion	SD	IQR	consensus
1. Family atmosphere	1) The family atmosphere is harmonious, and life is warm	4.76	Strongly agree	0.42	1	Congruence
	2) The family's financial pressure is not great	4.88	Strongly agree	0.32	1	Congruence
	3) Family members understand work and give more support for housework	4.88	Strongly agree	0.32	1	Congruence
2. Job support	4) Family members can handle various conflicts better	4.82	Strongly agree	0.38	1	Congruence
	5) When encountering work difficulties, family members can give reasonable suggestions	4.82	Strongly agree	0.38	1	Congruence
	6) Family members do not put pressure on job titles and job development	4.71	Strongly agree	0.46	1	Congruence
	7) Family members can use social relationships to provide work help for themselves	4.71	Strongly agree	0.46	1	Congruence
	8) Give data science professionals more independent working space	4.76	Strongly agree	0.42	1	Congruence

According to the expert opinions of Questionnaire II, the scores are all above 4.5 points, with an average score of 4.79, the lowest score being 4.59, and the highest score is 4.94, indicating that all indicators are significant; the standard deviation of each indicator item is between 0 ～1, all less than 1, indicating that the experts' opinions are

relatively concentrated. Based on the results, questionnaire III will be formulated for the final round of evaluation by experts. The results of the third round compared to the results of the second round, it is found that the average of the second round increased, the standard deviation decreased, the coefficient of variation decreased, the number of experts who put forward written suggestions reduced significantly, and the trend is stable.

4.1.4 Round 4: Resolved and Reported; In the fourth round, according to the evaluation results of the first three rounds of experts, Questionnaire III was formed and sent to the experts for evaluation. The results of the expert evaluation are shown in Table 4.7-4.9.

Table 4.7 Experts' Judgments on Individual Factors Affecting Data Science Professionals' Innovative Capacities

	Individual factors	Confirmation (Percentage)	Dis-Confirmation (Percentage)	Reject (Percentage)
1. Innovative thinking	1) Able to see the multi-faceted aspects of the problem and think about the problem from multiple angles	94%	0%	6%
	2) Like to seek different perspectives	88%	6%	6%
	3) Explore and study the incredible connections between things	94%	6%	0%
	4) have a rich imagination	100%	0%	0%
	5) Be willing to make problem assumptions and seize opportunities for change	94%	0%	6%
	6) Willingness to try new ideas and approaches	100%	0%	0%
2. Innovative personality	7) Curiosity, desire to explore and learn	100%	0%	0%
	8) Be creative, open to new ideas, and think outside the box	88%	6%	6%

		Confirmation (Percentage)	Dis-confirmation (Percentage)	Reject (Percentage)
	9) Dare to take risks and not be afraid of failure	94%	0%	6%
	10) Resilience, showing perseverance in the face of challenges and setbacks	94%	6%	0%
3. Innovation knowledge	11) Have rich subject expertise to lay the foundation for innovation	100%	0%	0%
	12) Willingness to learn about the latest research results, emerging trends, and developments in the research field	94%	0%	6%
	13) Have an interdisciplinary perspective and be able to integrate different perspectives to promote innovation	94%	0%	6%
	14) Proficiency in research methods, data analysis, and evaluation techniques	88%	6%	6%

Table 4.8 Experts' judgments on organizational factors affecting data science professionals' innovative capacities

	Organizational factors	Confirmation (Percentage)	Dis-confirmation (Percentage)	Reject (Percentage)
1. Organizational atmosphere	1) The school encourages data science professionals to learn actively	88%	6%	6%
	2) Schools tolerate teacher failure	88%	0%	12%
	3) Explore and study the incredible connections between things	94%	6%	0%
	4) The school publicly praises innovators who have achieved innovative results	94%	0%	6%
	5) School leaders have a strong sense of innovation	100%	0%	0%

		Confirmation (Percentage)	Dis-confirmation (Percentage)	Reject (Percentage)
	6) School leaders dare to take innovative risks	94%	6%	0%
2. Incentives for innovation	7) Schools give innovators monetary rewards and benefits	88%	6%	6%
	8) The school honors or commends innovators	94%	0%	6%
3. Career Development	9) Schools provide more training opportunities for innovators	94%	6%	0%
	10) Schools give innovators more opportunities to advance	88%	0%	12%
4. Team buildin	11) data science professionals have clear unity goals and clear assessment standards	94%	0%	6%
	12) The members of the team brainstorm, work, and goals are related	100%	0%	0%
	13) Team members supervise each other and agree with each other	88%	6%	6%
	14) Team members share resources and encourage each other	94%	6%	0%

Table 4.9 Experts' judgment on family factors affecting data science professionals' Innovative Capacities

	Family factors	Confirmation (Percentage)	Dis-confirmation (Percentage)	Reject (Percentage)
1. Family atmosphere	1) The family atmosphere is harmonious, and life is warm	100%	0%	0%
	2) The family's financial pressure is not great	94%	6%	0%
	3) Family members understand work and give more support for housework	88%	6%	6%
2. Job support	4) Family members can handle various conflicts better	94%	0%	6%

5) When encountering work difficulties, family members can give reasonable suggestions	94%	0%	6%
6) Family members do not put pressure on job titles and job development	88%	6%	6%
7) Family members can use social relationships to provide work help for themselves	94%	6%	0%
8) Give data science professionals more independent working space	94%	0%	6%

From Table 4.7-4.9, after four rounds of evaluation, the expert opinions are relatively unified, and the proportion of all options Confirmation is more than 88%, which achieves the expected goal of Delphi technology. To sum up, From Tables 4.4 and 4.7: Individual factors affecting Chinese university instructors' creativity ability: taking a diverse approach to challenges, diversity, exploring amazing connections, being creative, accepting problem assumptions and adjusting, and trying new things. Innovative, creative, risk-taking, resilient, and curious personality, expertise, understanding of current research trends, and an interdisciplinary approach that integrates multiple views enable creativity, research, data analysis, and evaluation skills. 17 experts' Opinion were Strongly agreed at 4.80, SD=0.39, IQR=1, Confirmation=94.5%, and the consensus of experts was Congruence. From Tables 4.5 and 4.8: Organizational factors affecting Chinese data science professionals' innovation. Organizational performance components, where the school fosters teacher learning, forgives instructors, discovers complicated relationships, and recognizes inventors publicly. School leaders innovate, school leaders take unique risks, administrators encourage innovation, schools reward inventors financially, schools honor inventors, career growth, schools train innovators, schools nurture innovators, data science professionals set clear goals and assessment standards, teams think, work and achieve goals, team members coordinate tasks, team members cooperate, support, and share resources.17 experts' Opinion were Strongly agreed at 4.77, SD=0.40, IQR=1, Confirmation=92.9%, and the consensus of experts was Congruence.

Family factors significantly impact Tables 4.9 and 4.9:The innovative capacities of Chinese data science professionals. Cultural values and norms within the family unit

shape a teacher's mindset toward creativity and novel thinking. Families that encourage independent thought and curiosity foster a more innovative approach in educators. Conversely, families that prioritize conformity may hinder creative potential. Emotional support from family members is also crucial for data science professionals to pursue innovation confidently. A nurturing and understanding family environment provides the encouragement needed to experiment with new teaching methods. On the other hand, a lack of support or criticism may deter educators from deviating from traditional practices. Additionally, the financial stability of a teacher's family plays a role in their innovative capacities. Financial constraints can limit access to resources and professional development opportunities, while financial security can empower data science professionals to invest in their innovative endeavors. Recognizing and nurturing these family factors can create a conducive environment for Chinese data science professionals to enhance innovation capabilities. 17 experts' Opinion were Strongly agreed at 4.79, SD=0.40, IQR=1, Confirmation=93.4%, and the consensus of experts was Congruence.

4.2 Research and Statistical Analysis Results

The results of the Delphi technique research are the opinions of 17 experts, which are authoritative and representative, but also have some subjectivity(Hanafin, 2004). To make the study more extensive and expected, the researchers further solicited opinions through a questionnaire survey and analyzed and verified the study results through SPSS software.

4.2.1 Questionnaire Design; the choice of measurement questionnaire is an essential issue in studying organizational behavior(Brace, 2018). The quality of questionnaire selection has a significant impact on the reliability of the results of the investigation. This Questionnaire is divided into three parts. The second part is the influence factors (independent variables) of Chinese data science professionals' innovative capacities according to 4.1 Delphi technical expert evaluation, including individual factors, organizational factors, family factors, and their specific options, a total of 36 items. The third part is the evaluation criteria of data science professionals' innovative capacities (dependent variable), according to the description of Chapter 2 (Table 2.6), including teaching innovation, scientific research innovation, and social service innovation. The

survey was designed in the form of a Likert five-level scale. The second part divided the agreement degree into very agree, relatively agree, neutral, moderately disagree, and significantly different. In the third part, the index was divided into important, general, unimportant, and very unimportant, and the corresponding scores were 5, 4, 3, 2, and 1. See Appendix _ E (Questionnaire IV) for details.

    4.2.2 Basic Information About the Sample Population; this survey uses the Questionnaire Star platform to distribute and collect questionnaires. Four hundred questionnaires were sent out, and 363 were effectively recovered, with a recovery rate of 90.75%. The sample population participating in the survey is shown in Table 4.10.

Table 4.10 Data of Sample Population Participated in the Survey

Item	Option	Frequency	Percentage
Sex	Male	226	62.30%
	Female	137	37.70%
Age	20-30	48	13.20%
	31-40	122	33.60%
	41-50	139	38.30%
	51-60	54	14.90%
Nature of the research undertaken	Basic Research	177	48.80%
	Applied Research	186	51.20%
Professional	Junior	93	25.60%
	Intermediate	106	29.20%
	Deputy Senior	109	30.00%
	Senior	55	15.20%
Education level	Below undergraduate	44	12.10%
	undergraduate	83	22.90%
	Master	103	28.40%
	Doctor	133	36.65

    From Table 4.10, in the 363 valid questionnaires, the gender of the sample population is mainly male, accounting for 62.3%. The age is primarily concentrated in 31-50 years old, of which 33.6% are 31-40 years old and 38.3% are 41-50 years old; The nature of the research is mainly applied research, accounting for 51.2%, basic research accounted for 48.8%, the title is primarily deputy senior, accounting for 30%, followed by intermediate, accounting for 29.2%; Most of the education level is a doctoral degree, accounting for 36.6%, followed by master's degree, accounting for 28.4%, followed by

undergraduate degree, accounted for 22.9%, and finally undergraduate and below, accounting for 12.1%.

4.2.3 Reliability Analysis SPSS28.0 analyzed the collected questionnaire data for mathematical statistics and analysis. The reliability test is mainly to test the reliability of the whole Questionnaire or the dimensions containing many items, which Cronbaha 's α usually expresses in research. When Cronbaha 's α is more than 0.7, the reliability of the Questionnaire is in the normal range. When Cronbaha's α is between 0.8-0.9, the reliability of the Questionnaire is excellent(Tavakol & Dennick, 2011). Import the survey data of the Questionnaire into SPSS 28.0 for analysis, and calculate the value of Cronbach's α, as shown in Table 4.11.

Table 4.11 Cronbaha 's α of the Survey

Latent variable	Cronbach's α	Number of terms	Total Cronbaha's α
Innovative thinking	0.931	6	
Innovative personality	0.909	4	
Innovation knowledge	0.903	4	
Organizational atmosphere	0.926	6	
Incentives for innovation	0.863	2	
Career development	0.869	2	0.977
Team building	0.912	4	
Family atmosphere	0.887	3	
Job support	0.919	5	
Teaching innovation	0.920	6	
Technological innovation	0.929	7	
Social service innovation	0.930	7	

From tale 4.11, Innovative thinking, Innovative personality, Innovation knowledge, Organizational atmosphere, Incentives for innovation, Career development, Team building, Family atmosphere, Job Support, Teaching innovation, Technological innovation, and social service innovation, The reliability coefficient is between 0.863 and 0.931, and the overall reliability of the Questionnaire is 0.977, which is greater than 0.9. This data group has good reliability, and it is appropriate to test its validity(Wainer & Braun, 2013).

4.2.4 Validity Analysis — Exploratory Factor Analysis (Fabrigar & Wegener, 2011)

The data statistics using SPSS28.0 statistical analysis software on Chinese data science professionals' innovative capacities influence factors from individual, organizational, and family factors are analyzed, the evaluation system of Chinese data science professionals' innovative capacities is analyzed, and the overall validity test.

KMO and Bartlett's test should be carried out before factor analysis to determine suitability. When the value of KMO is between 0 and 1, the closer the statistic is to 1, the stronger the correlation between variables is, and the better the effect of factor analysis is. In practical examination, the result is better when the KMO statistic is above 0.7; When the KMO statistic is less than 0.5, it is unsuitable for applying factor analysis(Umar, 2009).

Because SPSS can only analyze numerical values, and to facilitate analysis, all options (variables) are replaced by corresponding symbols(Puk E Nas, 2009). The alternate characters are arranged as shown in Table 4.12.

Table 4.12 Replacement Symbols of Indicator Item

	Project Content	Substitute Symbol
Innovative thinking	1) Able to see the multi-faceted aspects of the problem and think about the problem from multiple angles	IT1
	2) Like to seek different perspectives	IT2
	3) Explore and study the incredible connections between things	IT3
	4) have a rich imagination	IT4
	5) Be willing to make problem assumptions and seize opportunities for change	IT5
	6) Willingness to try new ideas and approaches	IT6
Innovative personality	7) Curiosity, desire to explore and learn	IP1
	8) Be creative, open to new ideas, think outside the box	IP2
	9) Dare to take risks and not be afraid of failure	IP3
	10) Resilience, showing perseverance in the face of challenges and setbacks	IP4
Innovation knowledge	11) Have rich subject expertise to lay the foundation for innovation	IK1
	12) Willingness to learn about the latest research results, emerging trends, and developments in the research field	IK2
	13) Have an interdisciplinary perspective and be able to integrate different perspectives to promote innovation	IK3

	14) Proficiency in research methods, data analysis, and evaluation techniques	IK4
Organizational atmosphere	1) The school encourages data science professionals to learn actively	OA1
	2) Schools tolerate teacher failure	OA2
	3) The school encourages data science professionals to come up with new ideas and can implement them	OA3
	4) The school publicly praises innovators who have achieved innovative results	OA4
	5) School leaders have a strong sense of innovation	OA5
	6) School leaders dare to take innovative risks	OA6
Incentives for innovation	7) Schools give innovators monetary rewards and benefits	II1
	8) The school honors or commends innovators	II2
Career Development	9) Schools provide more training opportunities for innovators	CA1
	10) Schools give innovators more opportunities to advance	CA2
Team building	11) data science professionals have clear unity goals and clear assessment standards	TB1
	12) The members of the team brainstorm, work, and goals are related	TB2
	13) Team members supervise each other and agree with each other	TB3
	14) Team members share resources and encourage each other	TB4
Family atmosphere	1) The family atmosphere is harmonious, and life is warm	FA1
	2) The family's financial pressure is not great	FA2
	3) Family members understand work and give more support for housework	FA3
Job support	4) Family members can handle various conflicts better	JS1
	5) When encountering work difficulties, family members can give reasonable suggestions	JS2
	6) Family members do not put pressure on job titles and job development	JS3
	7) Family members can use social relationships to provide work help for themselves	JS4
	8) Give data science professionals more independent working space	JS5
teaching innovation	1)Innovation can enhance the teaching experience through technology integration	TI1
	2)Innovation Can Enrich Active Learning Strategies	TI2
	3)Innovation can perfect the flipped classroom model	TI3
	4)Innovation Can Boost Project-Based Learning	TI4
	5)Innovation Can Boost Inclusive Teaching Practices	TI5
	6)Innovation Facilitates Personalized Learning Paths	TI6

technological innovation	1)Scientific research can lead to the identification of new phenomena, processes, or relationships	TGI1
	2)Innovation can deposit discoveries and reveal new phenomena	TGI2
	3)Innovation can drive technological progress	TGI3
	4)Innovation can drive improvements in research methods	TGI4
	5)Beds can boost tech commercialization	TGI5
	6)Innovation Can Facilitate Paradigm Shifts	TGI6
	7)Innovation can foster interdisciplinary collaboration	TGI7
social service innovation	1)Innovation can facilitate community-engaged research that addresses specific needs and challenges	SI1
	2)Innovation Can Boost Social Entrepreneurship Projects	SI2
	3)Innovation can make better service-learning programs	SI3
	4)Innovation can promote the development of innovation centers and incubators	SI4
	5)Innovation can advance policy research and advocacy	SI5
	6)Innovation can enhance capacity building and training	SI6
	7)Innovative technology can benefit society	SI7

4.2.4.1 Validity Analysis of Individual Factors Section

After analysis, the KMO and Bartlett test results of the individual factors part are shown in Table 4.13, and the KMO value of this part is 0.938, and the Significance is less than 0.001. Therefore, this part of the data is suitable for factor analysis.

Table 4.13 KMO and Bartlett Test Results for Individual Factors Section

KMO and Bartlett Check		
KMO sampling suitability measure		0.938
Bartlett test for sphericity	Approximate chi-square	4018.73
	Degree of freedom	91
	Significance	<.001

When extracting factors, specify that the minimum eigenvalue of the common factor to be extracted is 1. As shown in Table 4.14, in the individual factor dimension, the variance of the extracted common factors is more significant than 0.5, which means that all the indicators can be explained, and there is no need to eliminate the indicators.

Table 4.14 Extraction Factors for the Individual Factors Section

	Common Factor Variance	
	Initial value	Extraction Value
IT1	1	0.859
IT2	1	0.744
IT3	1	0.756
IT4	1	0.736
IT5	1	0.699
IT6	1	0.681
IP1	1	0.874
IP2	1	0.742
IP3	1	0.77
IP4	1	0.78
IK1	1	0.852
IK2	1	0.753
IK3	1	0.748
IK4	1	0.746
Extraction method: principal component analysis		

The total variance explained by the dimensions of the individual factors section is shown in Table 4.15, where the initial eigenvalue of the first component is 8.008, which is greater than 1; The initial eigenvalue of the second component is 1.462, which is greater than 1; The initial eigenvalue of the third component is 1.272, which is greater than 1; From the fourth component, the initial eigenvalues are all < 1. The total contribution rate of the three common factors is 76.721, which means the three common factors can explain about 76.72% of the total variance more than 60%, which is considered ideal when it reaches more than 60% (Som, 2005).

Table 4.15 Total Variance Results Explained by Individual Factors Dimension

	Total variance interpretation					
	Initial eigenvalue			The sum of the squares of the extracted load		
component	Total	Percent Variance	Cumulative%	Total	Percent Variance	Cumulative%
1	8.008	57.2	57.2	8.008	57.2	57.2
2	1.462	10.439	67.639	1.462	10.439	67.639
3	1.272	9.082	76.721	1.272	9.082	76.721
4	0.429	3.065	79.786			
5	0.401	2.862	82.648			
6	0.376	2.685	85.333			
7	0.359	2.563	87.895			
8	0.326	2.331	90.226			

9	0.309	2.205	92.431
10	0.286	2.042	94.472
11	0.261	1.865	96.337
12	0.196	1.398	97.735
13	0.167	1.195	98.93
14	0.15	1.07	100

Extraction method: principal component analysis

4.2.4.2 Validity Analysis of Organizational Factors Section

After analysis, the KMO and Bartlett test results of the tissue factor part are shown in Table 4.16, and the KMO value of this part is 0.916, with a significance < 0.001. Therefore, this part of the data is suitable for factor analysis.

Table 4.16 KMO and Bartlett Test Results for Organizational Factors Section

KMO and Bartlett Check		
KMO sampling suitability measure		0.916
Bartlett test for sphericity	Approximate chi-square	3729.379
	Degree of freedom	91
	Significance	<.001

When extracting factors, specify that the minimum eigenvalue of the common factor to be extracted is 1. As shown in Table 4.17, in the dimension of organizational factors, the variance of the extracted common factors is more significant than 0.5, which means that each index can be explained, and there is no need to eliminate the index.

Table 4.17 Extraction Factors for the Organizational Factors Section

Common Factor Variance		
	Initial value	Extraction Value
OA1	1	0.834
OA2	1	0.704
OA3	1	0.708
OA4	1	0.714
OA5	1	0.679
OA6	1	0.689
II1	1	0.535
II2	1	0.571
CA1	1	0.803
CA2	1	0.8
TB1	1	0.879
TB2	1	0.779
TB3	1	0.762
TB4	1	0.768

Extraction method: principal component analysis

The total variance results for the dimensional interpretation of the Organizational Factors section are shown in Table 4.18, where the initial eigenvalue of the first component is 7.481, which is greater than 1; The initial eigenvalue of the second component is 1.683, which is greater than 1; The initial eigenvalue of the third component is 1.063, which is greater than 1; From the fourth component, the initial eigenvalues are all < 1. The total contribution rate of the three common factors is 73.046, which means that the three common factors can explain about 73.05% of the total variance (more than 60%), and it is considered quite ideal when it reaches more than 60%.

Table 4.18 Total Variance Results Explained by Organizational Factors Dimension

	Total variance interpretation					
component	Initial eigenvalue			The sum of the squares of the extracted load		
	Total	Percent Variance	Cumulative%	Total	Percent Variance	Cumulative%
1	7.481	53.432	53.432	7.481	53.432	53.432
2	1.683	12.023	65.455	1.683	12.023	65.455
3	1.063	7.591	73.046	1.063	7.591	73.046
4	0.904	6.459	79.505			
5	0.409	2.919	82.425			
6	0.39	2.785	85.209			
7	0.357	2.547	87.757			
8	0.335	2.392	90.148			
9	0.315	2.249	92.397			
10	0.278	1.986	94.383			
11	0.236	1.683	96.067			
12	0.214	1.526	97.592			
13	0.182	1.302	98.894			
14	0.155	1.106	100			
Extraction method: principal component analysis						

4.2.4.3 Validity Analysis of Family Factors Section; After analysis, the KMO and Bartlett test results of the family factor part are shown in Table 4.19, and the KMO value of this part is 0.874, with a significance < 0.001. Therefore, this part of the data is suitable for factor analysis.

Table 4.19 KMO and Bartlett Test Results for Family Factors Section

KMO and Bartlett Check		
KMO sampling suitability measure		0.874
Bartlett test for sphericity	Approximate chi-square	2035.912
	Degree of freedom	28
	Significance	<.001

When extracting factors, specify that the minimum eigenvalue of the common factor to be extracted is 1. As shown in Table 4.20, in the dimension of family factors, the variance of the extracted common factors is more significant than 0.5, which means that all the indicators can be explained, and there is no need to eliminate the indicators.

Table 4.20 Extraction Factors for the Family Factors Section

Common Factor Variance		
	Initial value	Extraction Value
FA1	1	0.864
FA2	1	0.796
FA3	1	0.8
JS1	1	0.868
JS2	1	0.739
JS3	1	0.759
JS4	1	0.718
JS5	1	0.714
Extraction method: principal component analysis		

The total variance results explained by the dimensions of the family factors section are shown in Table 4.21, where the initial eigenvalue of the first component is 4.663, which is greater than 1; The initial eigenvalue of the second component is 1.596, which is greater than 1; From the third component, the initial eigenvalues are all < 1. The total contribution rate of the two common factors is 78.234, which means that the three common factors can explain about 78.23% of the total variance (more than 60%), which is considered quite ideal when it reaches more than 60%.

Table 4.21 Total Variance Results Explained by Family Factors Dimension

	Total variance interpretation					
	Initial eigenvalue			The sum of the squares of the extracted load		
component	Total	Percent Variance	Cumulative%	Total	Percent Variance	Cumulative%
1	4.663	58.288	58.288	4.663	58.288	58.288
2	1.596	19.946	78.234	1.596	19.946	78.234
3	0.395	4.936	83.17			
4	0.332	4.147	87.317			
5	0.322	4.022	91.339			
6	0.315	3.938	95.278			
7	0.222	2.777	98.054			
8	0.156	1.946	100			
Extraction method: principal component analysis						

4.2.4.4 Validity Analysis of innovative capacities Section

After analysis, the KMO and Bartlett test results of the innovative capacities factor part are shown in Table 4.22. The KMO value of this part is 0.95, and the Significance is less than 0.001. Therefore, this part of the data is suitable for factor analysis.

Table 4.22 Results of KMO and Bartlett Tests for the Innovative Capability Section

KMO and Bartlett Check		
KMO sampling suitability measure		0.95
Bartlett test for sphericity	Approximate chi-square	5658.872
	Degree of freedom	190
	Significance	<.001

When extracting factors, specify that the minimum eigenvalue of the common factor to be extracted is 1. As shown in Table 4.23, in the dimension of innovation capability factors, the variance of the extracted common factors is more significant than 0.5, which means that all indicators can be explained, and there is no need to eliminate indicators.

Table 4.23 Extraction Factors for the Innovative Capability Section

Common Factor Variance		
	Initial value	Extraction Value
TI1	1	0.871
TI2	1	0.715
TI3	1	0.621

TI4	1	0.671
TI5	1	0.733
TI6	1	0.73
TGI1	1	0.864
TGI2	1	0.677
TGI3	1	0.637
TGI4	1	0.716
TGI5	1	0.676
TGI6	1	0.688
TGI7	1	0.682
SI1	1	0.88
SI2	1	0.677
SI3	1	0.678
SI4	1	0.68
SI5	1	0.682
SI6	1	0.672
SI7	1	0.699
Extraction method: principal component analysis		

The total variance explained by the dimensions of the innovation capability section is shown in Table 4.24, where the initial eigenvalue of the first component is 10.141, which is greater than 1; The initial eigenvalue of the second component is 2.117, which is greater than 1; The initial eigenvalue of the third component is 1989, which is greater than 1; From the fourth component, the initial eigenvalues are all < 1. The total contribution rate of the three common factors is 71.235, which means they can explain about 71.24% of the total variance (more than 60%), which is considered ideal when it reaches more than 60%.

Table 4.24 Total Variance Results Explained by Innovative Capability Dimension

	Total variance interpretation					
	Initial Eigenvalue			The sum of the squares of the extracted load		
Component	Total	Percent Variance	Cumulative%	Total	Percent Variance	Cumulative%
1	10.141	50.707	50.707	10.141	50.707	50.707
2	2.117	10.583	61.29	2.117	10.583	61.29
3	1.989	9.944	71.235	1.989	9.944	71.235
4	0.557	2.784	74.018			
5	0.473	2.367	76.386			
6	0.457	2.284	78.669			
7	0.443	2.217	80.886			

8	0.422	2.108	82.994
9	0.409	2.047	85.042
10	0.388	1.94	86.982
11	0.364	1.818	88.8
12	0.344	1.718	90.517
13	0.331	1.657	92.174
14	0.307	1.535	93.709
15	0.301	1.504	95.213
16	0.266	1.328	96.542
17	0.246	1.23	97.772
18	0.193	0.963	98.735
19	0.137	0.685	99.42
20	0.116	0.58	100

Extraction method: principal component analysis

4.2.4.5 Global Validity Analysis; The factor analysis can further test the data validity when the KMO value is greater than 0. 5, and the Significance is less than 0. 05. The KMO and Bartlett test results for the survey questionnaire are shown in Table 4.25, with a KMO value of 0.962 and a significance < 0.001. Therefore, the data are suitable for factor analysis.

Table 4.25 Questionnaire IV KMO and Bartlett Test Result

KMO and Bartlett Check		
KMO sampling suitability measure		0.962
Bartlett test for sphericity	Approximate chi-square	17356.452
	Degree of freedom	1540
	Significance	<.001

The researchers chose exploratory factor analysis to analyze the total variance explanation table and rotation component matrix table through the calculation of SPSS28.0 software, as shown in Table 4.26:

Table 4.26 Total Variance Interpretation Table and Rotation Component Matrix Table of Questionnaire IV

Element	Initial Eigenvalue			The sum of Squares of Rotation Load		
	Total	Percent Variance	Cumulative %	Total	Percent Variance	Cumulative %

1	25.182	44.969	44.969	5.486	9.797	9.797
2	2.518	4.496	49.465	4.921	8.788	18.585
3	2.467	4.406	53.871	4.771	8.520	27.105
4	2.061	3.680	57.552	4.596	8.208	35.313
5	1.942	3.468	61.020	4.319	7.712	43.025
6	1.544	2.758	63.778	4.164	7.436	50.461
7	1.452	2.593	66.370	3.176	5.671	56.132
8	1.315	2.348	68.718	2.952	5.272	61.404
9	1.260	2.250	70.968	2.816	5.029	66.433
10	1.187	2.119	73.087	2.456	4.386	70.819
11	1.054	1.882	74.969	1.735	3.097	73.916
12	.878	1.568	76.536	1.467	2.620	76.536
13	.606	1.082	77.619			
14	.581	1.038	78.657			
15	.542	.968	79.625			
16	.515	.920	80.545			
17	.480	.858	81.403			
18	.465	.831	82.234			
19	.454	.810	83.044			
20	.439	.785	83.828			
21	.427	.762	84.591			
22	.419	.748	85.339			
23	.399	.713	86.052			
24	.389	.695	86.747			
25	.384	.686	87.433			
26	.372	.664	88.096			
27	.364	.650	88.746			
28	.350	.625	89.371			
29	.341	.609	89.981			
30	.332	.593	90.573			
31	.315	.562	91.135			
32	.312	.558	91.693			
33	.303	.541	92.233			
34	.295	.527	92.761			
35	.284	.506	93.267			
36	.270	.482	93.749			
37	.264	.471	94.219			
38	.260	.464	94.683			
39	.256	.458	95.141			
40	.247	.441	95.582			
41	.226	.403	95.985			
42	.216	.386	96.371			
43	.209	.374	96.745			
44	.200	.357	97.102			
45	.188	.335	97.437			
46	.177	.317	97.754			

47	.170	.303	98.057
48	.158	.283	98.340
49	.145	.259	98.599
50	.141	.251	98.850
51	.129	.230	99.080
52	.126	.224	99.304
53	.111	.198	99.502
54	.103	.183	99.685
55	.098	.175	99.860
56	.078	.140	100.000

It can be seen from the table that the percentage of the first factor in the total variance explanation table is 9.797% < 40%, indicating that there is no standard severe method deviation problem in this group of data; Second, observe the 12th factor in the table after rotation cumulative variance explanation rate, the value is 76. 536% > 60%, indicating that the 12 factors can effectively represent 76. 536% of the questionnaire information. The factor loading coefficients in the rotated principal component matrix table are then observed as shown in Table 4.27:

Table 4.27 Factor Load Factor of Questionnaire IV

item	Element											
	1	2	3	4	5	6	7	8	9	10	11	12
TB 1					0.767							
TB 2					0.672							
TB 3					0.696							
TB 4					0.674							
FA 1					0.679							
FA 2					0.638							
FA 3								0.773				
JS1								0.648				
JS2								0.744				

JS3					0.722				
JS4						0.752			
JS5						0.662			
TI1						0.663			
TI2						0.694			
TI3	0.829								
TI4	0.706								
TI5	0.726								
TI6	0.71								
TGI1	0.685								
TGI2	0.679								
TGI3									0.746
TGI4									0.718
TGI5							0.772		
TGI6							0.802		
TGI7				0.814					
SI1				0.682					
SI2				0.703					
SI3				0.724					
SI4						0.798			
SI5						0.751			
SI6						0.745			
SI7			0.861						

TB 1				0.746						
TB 2				0.806						
TB 3				0.713						
TB 4				0.748						
FA 1			0.811							
FA 2			0.661							
FA 3			0.626							
JS1			0.659							
JS2			0.72							
JS3			0.77							
JS4		0.788								
JS5		0.613								
TI1		0.672								
TI2		0.674								
TI3		0.625								
TI4		0.677								
TI5		0.677								
TI6	0.838									
TGI 1	0.698									
TGI 2	0.684									
TGI 3	0.706									
TGI 4	0.699									
TGI 5	0.691									

TGI 6	0.73										

From Tables 4.26 and 4.27, the percentage of the sum of the squares of the first-factor rotation load in the total variance explanation table is 9.797% < 40%, indicating that there is no standard severe method deviation problem in this group of data; Second, observe the 12th factor in the table after rotation cumulative variance explanation rate, the value is 76. 536% > 60%, indicating that the 12 factors can effectively represent 76. 536% of the questionnaire information. The factor loading coefficients in the rotated principal component matrix table are then observed as follows; The first factor is 1 to 7 questions of the social service innovation dimension, and the factor loading coefficient ranges from 0.684 to 0.838.

The second factor is 1 to 7 questions of the technical innovation dimension, and the factor loading coefficient ranges from 0.613 to 0.788;

The third factor is 1 to 6 questions of the Organizational atmosphere dimension, and the factor load value is between 0.679 and 0.829;

The fourth factor is Teaching innovation dimension 1 to 6 questions; the factor load value is between 0.626 and 0.811.

The fifth factor is the innovative thinking dimension 1 to 6, and the factor loading coefficient is between 0.638 and 0.767;

The sixth factor is 1 to 5 questions of Job support dimension, and the factor load value is between 0.713 and 0.861;

The seventh factor is team building 1 to 4, and the factor load value is between 0.682 and 0.814;

The eighth factor is 1 to 4 questions of the Innovative personality dimension, and the factor load value is between 0.648 and 0.773;

The ninth factor is 1 to 4 questions of Innovation knowledge dimension, and the factor load value is between 0.662 and 0.752;

The tenth factor is 1 to 3 questions of the Family atmosphere dimension, and the factor load value is between 0.745 and 0.798;

The eleventh factor is 1 and 2 of the Career development dimensions, and the factor loading values are 0.772 and 0.802;

The twelfth factor is Incentives for Innovation 1 and 2, and the factor load value is 0.746 and 0.718.

The above load does not appear that the same item belongs to two factors or has two or more different dimensions under the same factor, which meets the expected division of 12 sizes. This data group has good construct validity and is suitable for further analysis.

4.2.5 Validity Analysis-Confirmatory Factor Analysis; to ensure the study's rigor, confirmatory factor analysis is further carried out on the questionnaire data, and the Questionnaire's model fitting, discriminant validity, and convergent validity are tested again(Harrington, 2009). After calculation by SPSS 28.0, the analysis result is shown in Table 4.28:

Table 4.28 Model Fitness, Discriminant Validity, and Convergent Validity of Questionnaire IV

Common Index	X^2	Df	Chi-square degree of freedom ratio	GFI	RMSEA	CFI	NFI	NNFI
Judgement Standard	-	-	<3	>0.8	<0.10	>0.8	>0.8	>0.8
Value	2047.325	1418	1.444	0.889	0.035	0.963	0.889	0.959

It can be seen from the table that the chi-square degree of freedom ratio of this model is 1.444 < 3, the RMSEA value is 0.035 < 0.1, and the importance of GFI, CFI, NFI, and NNFI is 0.889, 0.963, 0.889 and 0.959 respectively, which are all greater than 0.8. Then we can judge the convergent validity of the scale by calculating the variance extract AVE value and the combined reliability CR value of each variable. When the AVE value of the dimension data is greater than 0. 5, and the combined reliability CR value is greater than 0. 7, this data group has good convergent validity (Brown, 2015). After the operation of SPSS 28.0, as shown in Table 4.29:

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Table 4.29 AVE and CR for Questionnaire IV

Factor	Average variance extract(AVE) values	Combined reliability(CR) value
Innovative thinking	0.706	0.934
Innovative personality	0.735	0.916
Innovation knowledge	0.711	0.907
Organizational atmosphere	0.689	0.929
Incentives for innovation	0.761	0.864
Career development	0.772	0.871
Team building	0.736	0.917
Family atmosphere	0.74	0.894
Job support	0.72	0.926
Teaching innovation	0.686	0.927
Technological innovation	0.669	0.933
Social service innovation	0.679	0.935

As seen from that table, Innovative thinking, Innovative personality, Innovation knowledge, Organizational atmosphere, Incentives for innovation, Career development, Team building, Family atmosphere, Job Support, Teaching innovation, technical innovation, social service innovation, The AVE values of 12 dimensions were all greater than 0. 5. The CR values were all greater than 0. 7, which indicated that the data had good convergent validity(Lance & Vandenberg, 2002). Then the discriminant validity was tested. The discriminant validity of the Questionnaire is shown in Table 4.30.

Table 4.30 Discriminant Validity of Questionnaire IV

	Mean	SE	1	2	3	4	5	6	7	8	9	10	11	12
1. Innovative thinking	3.25	1.02	**0.84**											
2. Innovative personality	3.24	1.06	0.60	**0.86**										
3. Innovation knowledge	3.28	1.02	0.64	0.58	**0.84**									

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Dimension	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
4.Organizational atmosphere	3.22	0.98	0.61	0.45	0.57	**0.83**								
5. Incentives for innovation	3.32	1.16	0.58	0.48	0.52	0.59	**0.87**							
6. Career development	2.96	1.11	0.50	0.45	0.47	0.46	0.45	**0.88**						
7. Team building	3.32	1.05	0.57	0.49	0.53	0.57	0.51	0.53	**0.86**					
8. Family atmosphere	3.25	1.10	0.51	0.48	0.50	0.50	0.50	0.43	0.51	**0.86**				
9. Job support	3.21	1.03	0.46	0.48	0.51	0.51	0.47	0.39	0.49	0.45	**0.85**			
10. Teaching innovation	3.22	0.98	0.62	0.59	0.60	0.57	0.54	0.44	0.57	0.55	0.54	**0.83**		
11. Technological innovation	3.25	0.94	0.67	0.58	0.63	0.65	0.53	0.57	0.64	0.57	0.51	0.56	**0.82**	
12. Social service innovation	3.29	0.97	0.64	0.62	0.61	0.56	0.52	0.48	0.52	0.47	0.49	0.54	0.60	**0.82**

Ps: The second column of the table is the mean value of the dimension, the third column is the standard deviation, the bold data on the diagonal line is the AVE square root of the dimension, and the other data are the Pearson correlation coefficients between the dimension and different dimensions (Gatignon & Gatignon, 2014).

As can be seen from Table 4.30; The correlation coefficient between innovative thinking and the other dimensions is between 0.46 and 0.67, the AVE square root value of the dimension is 0.84, and the AVE honest root value is greater than the correlation coefficient between the dimension and technical innovation, which is 0.67; The correlation coefficient between the innovative personality and the other dimensions is

between 0.45 and 0.62, and the AVE square root value of the dimension is 0.86, which is greater than the correlation coefficient of 0.62 between the dimension and Social service innovation; The correlation coefficient between Innovation knowledge and the other dimensions is between 0.47 and 0.63, and the AVE square root value of the dimension is 0.84, which is greater than the correlation coefficient of 0.63 between the dimension and; The correlation coefficient between the organizational atmosphere and the other dimensions is between 0.46 and 0.65, and the AVE square root value of the dimension is 0.83, which is greater than the correlation coefficient of 0.65 between the dimension and the technical innovation; The correlation coefficient between Incentives for innovation and the other dimensions is between 0.45 and 0.54, and the AVE square root value of the dimension is 0.87, which is greater than the correlation coefficient of 0.54 between the dimension and Teaching innovation; The correlation coefficients between Career development and the other dimensions are between 0.39 and 0.57, and the AVE square root value of the dimension is 0.88, which is larger than the correlation coefficient of 0.57 between the dimension and Technical innovation; The correlation coefficient between Team building and the other dimensions is between 0.49 and 0.64, and the AVE square root value of the dimension is 0.86, which is greater than the correlation coefficient of 0.64 between the dimension and Technical innovation; The correlation coefficient between the Family atmosphere and the other dimensions is between 0.45 and 0.57, and the AVE square root value of the dimension is 0.86, which is greater than the correlation coefficient of 0.57 between the dimension and Technical innovation; The correlation coefficient between Job support and the other dimensions is between 0.49 and 0.54, and the AVE square root value of the dimension is 0.85, which is greater than the correlation coefficient of 0.54 between the dimension and Teaching innovation; The correlation coefficient between Teaching innovation and the other dimensions is between 0.54 and 0.56, and the AVE square root value of the dimension is 0.83, which is greater than the correlation coefficient of 0.56 between the dimension and Technological innovation; The square root value of AVE of Technical innovation is 0.82, more significant than the correlation coefficient of 0.6 between this dimension and the Social service innovation dimension, and the square root value of AVE of Social service innovation is 0.82. Therefore, the AVE value of the dimension of Questionnaire IV data

is greater than the Pearson correlation coefficient of the dimension and the other dimensions, and the data can be considered to have good discriminant validity.

4.3 Summary

4.3.1 Results of the Delphi Technique Study; the researchers used the Delphi technique to analyze the influencing factors of Chinese data science professionals' innovative capacities. Firstly, with the theme of What factors do you think to affect the innovative capacities of Chinese data science professionals, 158 expert opinions were collected through brainstorming. The researchers divided these opinions into three categories: individual factors, organizational factors, and family factors. After four rounds of Delphi technology to solicit opinions, experts have reached a consensus on the factors affecting the innovative capacities of data science professionals, including 14 individual factors, 14 organizational factors, and 8 family factors.17 experts' Opinion were Strongly agreed at 4.79, SD=0.39, IQR=1, Confirmation=93.5%, and the consensus of experts was Congruence.

4.3.2 Validate and Analyze the Investigation Result; in order to ensure the scientificity and rationality of the research results, 363 data science professionals were investigated by questionnaire survey. The data of the survey results were analyzed by SPSS software, which passed the reliability test, the total variance interpretation table in exploratory factor analysis, the component matrix after rotation and the model fitness test, the discrimination validity test, and the aggregation validity test in confirmatory factor analysis. It is suitable for structural equation model analysis. When Cronbaha's α is more than 0.7, the questionnaire data can be considered in the normal reliability range. The Questionnaire is deemed reliable when Cronbaha's α is in the range of 0.8-0.9. The Questionnaire is considered reliable when Cronbaha 's α is more than 0.9. Through verification, the Total Cronbaha's α of the Questionnaire is 0.977, which shows that the Questionnaire has excellent reliability. Exploratory factor analysis was used to analyze the validity of the Questionnaire. Generally, when testing the validity, the first observation is the KMO value; when the KMO value is more significant than 0.5 and the Significance is less than 0.05, the data can be used for factor analysis. The overall KMO

of the Questionnaire is 0.962, significant < 0.001, suitable for exploratory factor analysis. After the analysis of SPSS 28.0, the same item does not belong to two factors or the same factor has two or more different dimensions of the items, in line with the expected division of 12 dimensions, indicating that the Questionnaire has good construct validity.

The researchers also did a confirmatory factor analysis to ensure the study's rigor. Through the analysis of SPSS 28.0, the data dimension AVE value of the Questionnaire is greater than the Pearson correlation coefficient of the other dimensions, which can prove that the Questionnaire has good discrimination validity. Through the above analysis, it can be concluded that most of the researchers have highly recognized the results of the Delphi technique, the reliability and validity of the Questionnaire are trustworthy, and the influencing factors of Chinese data science professionals' innovative capacities proposed in this study are scientific and reasonable.

CHAPTER 5
DISCUSSION AND RECOMMENDATION

This chapter provides a discussion and summary of the research, contributions, limitations, and prospects for future research, puts forward the influencing factors model of Chinese data science professionals' innovative capacities, and introduces the model's mechanism in detail.

        5.1 Discussion and Summary

        5.2 Contribution of the Study

        5.3 Limitations of the Study

        5.4 Prospects for Future Research

5.1 Discussion and Summary

In the fourth chapter, the researchers use the Delphi technique to discuss the influence factors of Chinese data science professionals' innovative capacities, use the questionnaire survey method to investigate the results of the Delphi technique, and use SPSS28.0 statistical software to analyze the reliability and validity of the research results. From the analysis results, the reliability and validity of the survey questionnaire are very high; we can use the questionnaire results for further analysis. The analysis was performed using AMOS 21. 0 software.

5.1.1 Analysis of Influencing Factors of the Independent Variable on the Dependent Variable Putting the statistical results into AMOS 21.0, we get the results shown in Table 5.1:

Table 5.1 Analysis of Influence Factors of Independent Variables on the Dependent
Variable

	Estimate	S.E.	C.R.	P
innovative capacities<---Individual Factors	0.526	0.044	11.858	***
innovative capacities<---Organization factors	0.393	0.04	9.932	***
innovative capacities<---Family Factors	0.222	0.042	5.257	***

Ps: (1) The significant P value cannot be displayed because it is less than 0.001,
so, the result is expressed as * * *
(2) The situation is the same as that in Table 5.2-5.4

It can be seen from the table 5.1 that the influence coefficient of personal factors on innovative capacities is 0.526 > 0, indicating a positive influence, P < 0.001, indicating that individual factors can positively affect data science professionals' innovative capacities; The influence coefficient of organizational factors on data science professionals' innovative capacities is 0.393 > 0, indicating a positive influence, P < 0.001, indicating that organizational factors can positively affect data science professionals' innovative capacities; Family factors on the impact of an innovative capacity coefficient is 0.222 > 0, P < 0.001, indicating that family factors can positively affect the innovative capacity of data science professionals. Therefore, personal, organizational, and family factors significantly positively affect innovative capacities (Afthanorhan & Ahmad, 2014).

For further analysis, use AMOS21.0 to run the results of the model at the factor level, as shown in Figure 5.1:

Figure 5.1 Influence of the independent variable on the dependent variable

5.1.2 Dimensional Analysis of the Influence of Independent Variables on Dependent Variable

5.1.2.1 Dimensional Analysis of the Influence of Independent Variables on Teaching Innovation

Based on factor analysis, the researchers conducted dimensional research. In the AMOS model, the P value reflects the significance level between each variable and is bounded by 0.05. If P < 0.001, it has a very high significance level; if P < 0.01, it has

a better significance level; if P < 0.05, the significance level is acceptable; If P > 0.05, then the significance level is unacceptable(Shek & Yu, 2014).

The obtained model simulation graph is analyzed by using AMOS21.0, and the influence of independent variables on Teaching innovation is shown in Table 5.2:

Table 5.2 Effect of Independent Variables on Teaching Innovation

	Estimate	S.E.	C.R.	P
TI<---IT	0.156	0.033	4.705	***
TI<---IP	0.162	0.032	5.073	***
TI<---IK	0.122	0.033	3.678	***
TI<---OA	0.088	0.035	2.533	0.011
TI<---II	0.051	0.029	1.753	0.08
TI<---CA	-0.02	0.03	-0.666	0.505
TI<---TB	0.108	0.032	3.357	***
TI<---FA	0.119	0.031	3.886	***
TI<---JS	0.126	0.033	3.821	***

From Table 5.2, In the nine independent variable path results of the Teaching innovation dimension of the dependent variable, the significant P value of II to T.I. is 0.08 > 0.05, and the significant P value of C.A. to T.I. is 0.505 > 0.05. Incentives for innovation and career development were not significant for the two paths of teaching innovation, while the other seven paths were significant.

5.1.2.2 Dimensional Analysis of the Impact of Independent Variables on Technological Innovation

The obtained model simulation graph is analyzed by using AMOS21.0, and the influence of independent variables on technical innovation is shown in Table 5.3:

Table 5.3 Effect of Independent Variables on Technological Innovation

	Estimate	S.E.	C.R.	P
TGI<---IT	0.16	0.029	5.505	***
TGI<---IP	0.092	0.028	3.297	***
TGI<---IK	0.109	0.029	3.732	***
TGI<---OA	0.196	0.03	6.422	***
TGI<---II	-0.018	0.026	-0.694	0.488
TGI<---CA	0.123	0.027	4.593	***
TGI<---TB	0.152	0.028	5.404	***
TGI<---FA	0.1	0.027	3.705	***
TGI<---JS	0.03	0.029	1.024	0.306

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From Table 5.3, In the nine independent variable path results of the dependent variable technical innovation dimension, the significant P value of II to TGI is 0.488 > 0.05, and the significant P value of J.S. to TGI is 0.306 > 0.05, which can be explained. Incentives for innovation and Job support were not significant for the two paths of technical innovation, while the other seven paths were significant.

5.1.2.3 Dimensional Analysis of the Impact of Independent Variables on Social Service Innovation

The obtained model simulation graph is analyzed by using AMOS21.0, and the influence of independent variables on Social service innovation is shown in Table 5.4:

Table 5.4 Effect of Independent Variables on Social Service Innovation

	Estimate	S.E.	C.R.	P
SI<---IT	0.194	0.033	5.829	***
SI<---IP	0.226	0.032	7.067	***
SI<---IK	0.143	0.033	4.288	***
SI<---OA	0.123	0.035	3.526	***
SI<---II	0.037	0.029	1.28	0.2
SI<---CA	0.065	0.03	2.124	0.034
SI<---TB	0.027	0.032	0.836	0.403
SI<---FA	0.005	0.031	0.175	0.861
SI<---JS	0.067	0.033	2.043	0.041

From Table 5.4, Among the nine independent variable path results on the dependent variable Social service innovation dimension, the significant P value of II to SI is 0.2 > 0.05, the significant P value of T.B. to SI is 0.403 > 0.05, and the significance P value of F.A. to SI is 0.861 > 0.05. The results of Incentives for innovation, Team building, and Family atmosphere are insignificant for the three paths of technical innovation, and the other six paths are significant.

5.1.2.4 Dimension-level Model Result

Use AMOS21.0 to analyze all the data at the dimension level and run the simulated model diagram, as shown in Figure 5.2:
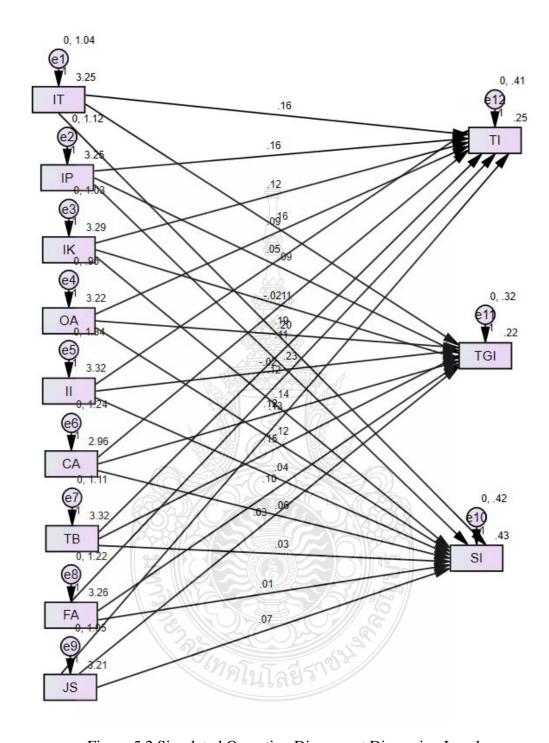
Figure 5.2 Simulated Operation Diagram at Dimension Level

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5.1.3 Model of Influencing Factors of Data Science Professionals' Innovative Capacities in China

According to the above analysis results, a model was created to analyze factors affecting Chinese data science professionals' innovative capacities, as shown in Figure 5.3.
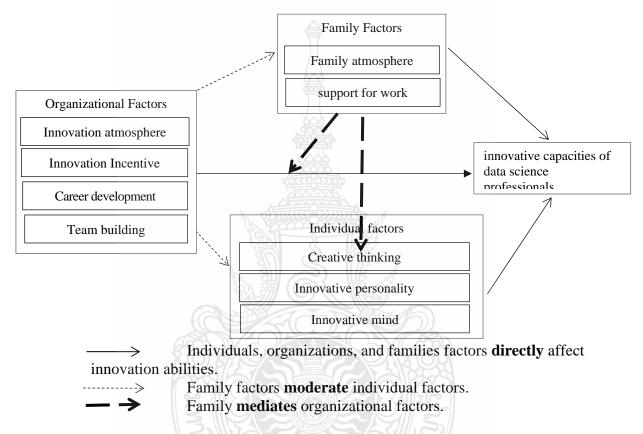
Figure5.3 A Model of Factors Affecting Data Science Professionals' Innovative Capacities

Individual, organizational, and familial factors directly impact university instructors' capacity for innovation. Organizational factors influence both families and individuals, indirectly affecting inventiveness. Family factors indirectly influence organizational growth and, ultimately, the innovative capacity of university instructors. Factors affecting instructors' ability to foster innovation include diverse perspectives, interdisciplinary research, imagination, adaptability, and willingness to try new methods. Innovative data science professionals possess curiosity, critical thinking, open-

mindedness, and resilience. An excellent organizational innovation atmosphere encourages participation, exploration, and failure tolerance(Savina, 2019).

5.1.4 Mechanism of Influencing Factors on data science professionals' innovative capacities

(1) The more innovative the data science professionals are, the stronger their innovative capacities is. Innovative thinking, often called critical or divergent thinking, refers to the ability to generate novel ideas, explore non-traditional solutions, and respond to challenges with creativity and openness. Innovative thinking has a profound impact on the innovative capacities of data science professionals and plays an essential role in changing teaching methods and affecting students' overall learning experience(Rahardjanto et al., 2019). First, innovative thinking enables data science professionals to identify new opportunities and design innovative teaching methods. It encourages them to go beyond traditional teaching methods and embrace emerging technologies, interactive platforms, and experiential learning opportunities. data science professionals can create a dynamic and enriching learning environment by constantly seeking new ways to engage students and cater to diverse learning styles. Secondly, innovative thinking enables data science professionals to adapt to the changing educational pattern. With the continuous development of the field of education, data science professionals must be able to respond to new challenges and requirements effectively. By cultivating innovative thinking, university educators can keep abreast of the latest teaching progress, research results, and best practices to improve their teaching methods continuously. In addition, innovative thinking improves the ability of data science professionals to solve problems. When encountering complex issues or obstacles in the classroom, data science professionals with innovative solid abilities can deal with problems from various angles and propose creative solutions. This adaptability and resourcefulness are invaluable in meeting the diverse needs of students and overcoming teaching-related challenges.

(2) The more innovative personality of data science professionals, such as curiosity, willingness to take risks, and strong perseverance, the stronger their innovative capacities(Zhou, 2021). People with innovative characters have certain traits and characteristics that contribute to their ability to generate new ideas, respond

creatively to challenges, and promote meaningful innovation:Strong curiosity will drive data science professionals to explore different topics and fields, stimulate the generation of creativity, encourage data science professionals to understand the latest progress, trends and research results in their research fields, cultivate data science professionals' critical thinking and problem-solving ability, and be more likely to meet challenges with an open mind, so as to propose creative and original solutions(Tamsah et al., 2021);Creative and open-minded data science professionals are not easily bound by traditional thinking, which enables them to meet teaching and research challenges with a new perspective, more willing to try innovative technologies, integrate emerging technologies, and generate a wide range of innovative ideas;data science professionals with adventurous spirit are more likely to pursue unknown research directions in scientific research, stimulate the willingness to take risks and bring about breakthrough discoveries; Not afraid of failure can enable data science professionals to learn from setbacks and mistakes, even in the face of obstacles can better adhere to the pursuit of research;University faculty with resilience and persistence, who are able to overcome the obstacles and challenges that arise in the innovation process, are more willing to take calculated risks, enabling faculty to sustain their innovation efforts over time, ensuring that they can overcome challenges and succeed, thus making an impact in their field. Overall, innovative personalities enable university faculty to think outside the box, take risks, collaborate effectively, and conduct research with enthusiasm and dedication(Pineda-B A Ez et al., 2019). Embodying these traits can significantly improve their ability to innovate and produce impactful research results.

(3) The more abundant the data science professionals' innovative knowledge reserve is, the stronger their innovative capacities is. The innovative knowledge of data science professionals can significantly affect their innovative capacities because it plays a vital role in shaping their teaching research and problem-solving methods(Sun et al., 2020): data science professionals with rich professional knowledge of disciplines have a deep understanding of the basic concepts, methodologies, and historical background of their fields, which enables them to find gaps in existing knowledge and propose research questions that break through the boundaries of disciplines; A wealth of subject expertise enables university faculty to develop valid

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research hypotheses, thereby increasing the chances of producing valuable research results; The interdisciplinary perspective can allow data science professionals to understand complex problems from multiple perspectives(Van den Beemt et al., 2020), to have a more comprehensive and detailed understanding of the research theme; Many real-world challenges are multifaceted and cannot be adequately addressed from the perspective of a single discipline. The interdisciplinary approach enables data science professionals to use different expertise to solve complex problems and promote innovative problem-solving strategies; Proficiency in research methods enables faculty members to design robust, valid, and reliable research that produces more trustworthy results; Proficiency in data analysis technology can allow data science professionals to extract meaningful insights from the collected data(Jackson, 2019), ensure rigorous research, accurate data analysis, and effective communication of research results, thus improving the innovative capacities of data science professionals.

(4) The better the innovative atmosphere is, the better the innovative capacities is(Alblooshi et al., 2021)**.** Universities that advocate innovation will actively encourage data science professionals to participate in training or further education to learn new knowledge, so as to improve the innovative capacities of data science professionals;Universities encourage adventure and exploration, and tolerate data science professionals' failure, which will alleviate their worries about innovation failure, enrich their exploration spirit, and be more willing to explore new theories, new technologies and new methods, so as to continuously improve their innovative capacities(Xie et al., 2018);Universities encourage data science professionals to put forward innovative ideas and viewpoints frequently, and put new ideas and perspectives into practice in the organization, can give full play to the creativity of data science professionals, often get new ideas, new ideas, will be more willing to learn, to explore, to test, more exploratory spirit, therefore, its innovative capacities will be more robust;If other data science professionals in the university have innovative consciousness in their work and dare to put forward different methods and ideas from others, a good atmosphere will be formed, and data science professionals will get more new knowledge, new ideas and new ideas, and their innovative capacities will be higher;If the leadership of the university is open-

minded, has a strong sense of innovation, and dares to take responsibility for innovation risks, it will be better for data science professionals to worry about the failure of innovation, and dare to put forward and adopt new ideas, new methods and new knowledge, the higher their innovative capacities.

(5) University professors' capacity for innovation will increase in direct proportion to how well they perceive the innovation reward scheme. According to economic exchange theory and social exchange theory, data science professionals will feel their value realized and work harder to improve their abilities if they can get material rewards and spiritual encouragement after contributing to their schools(Tetiana et al., 2018). Therefore, when data science professionals think that they will be rewarded with money or welfare benefits for their innovative achievements, they are more willing to make more efforts to improve their knowledge, improve their innovative capacities and strive for more returns. At the same time, this perception will encourage data science professionals to collect more information, explore their imagination and creativity, and learn from others to improve their innovative abilities continuously.

(6) The more career development opportunities the university faculty perceived the organization provided, the stronger their innovative capacities was. According to the social exchange theory, if data science professionals can get more career development opportunities at the university, they will perceive their own university's concern for their future and their concern and think that the university can be trusted and worthy of paying for them(Zepeda, 2019). When data science professionals perceive that their efforts will be more rewarded by the organization in terms of career development opportunities, they will strive to develop new ideas, new ideas, strive to learn and accumulate necessary knowledge, and bravely explore new fields. Therefore, they will be more actively prepared to undertake the knowledge, technology, and personal ability needed for innovative work, and the degree of innovation investment will be increased to a greater extent to improve their innovative capacities(Smith & Gillespie, 2023).

(7) The better the team atmosphere, the stronger the cooperation, and the higher the level, the stronger the innovative capacities. One of the most important reasons we need to build a team is that it can accomplish something or a task that one person cannot accomplish alone(Ozigbo et al., 2020). improved team building, team goal

setting is more democratic and open, the distribution system of work tasks will be more reasonable, and the assessment criteria will be more open and transparent. Clear team goals can give data science professionals a clear direction for efforts, learning, and knowledge accumulation more targeted, so their innovative capacities will be (Solodova et al., 2018). The requirement of cooperation between data science professionals is straightforward, enabling data science professionals to form an effective exchange mechanism of knowledge and information, learn from each other's strengths and complement each other's weaknesses, inspire each other, and have more vital innovative capacities. The cooperation of team members mainly completes the work of the team; in the process of team operation, team members must communicate and share information; the higher the frequency of information communication within the team, the more diversified the means of communication, the stronger the team's collaboration ability, so that the team creativity is constantly improved.

(8) The better the family atmosphere of data science professionals, the stronger their innovative capacities. data science professionals spend most of their time with their families except for their work. The attitude of family members will inevitably have an impact on the emotions of data science professionals. The quality of their feelings will affect their work engagement, the direction of efforts, learning effect, sources of knowledge and information, etc., which will profoundly impact the innovation of data science professionals(Epstein et al., 2018). Suppose the family atmosphere of data science professionals is harmonious. In that case, they can feel the warmth of life, they will have a strong sense of responsibility to the family, and they are willing to repay the family through more efforts, so they will invest more energy to improve their ability, so their innovative capacities will be higher. data science professionals with little economic pressure will not make money because of the stress of life. Still, they will have a better career plan for their future(Soomro et al., 2018). They will strive to improve their working ability through continuous learning and development, so their innovative capacities will be more vital. Family members understand and support their work, give them space without interference, and undertake housework to provide them with more time, industrial technicians will devote more and more to their work so that they will accumulate more knowledge and experience, and their innovative capacities will be

(Collins et al., 2022).

(9) The more significant the work support from family members, the stronger the innovative capacities of data science professionals(French et al., 2018)**.** Suppose the family members of data science professionals can correctly deal with work-family conflict and support them to put more energy into their work. In that case, they will be less disturbed by the outside world and more devoted to their work so that data science professionals will have higher learning efficiency, more knowledge accumulation, and more vital innovative capacities. When other family members can give valuable suggestions for the difficulties data science professionals encounter in their work, they have more extensive sources of knowledge, information, and broader ideas, so their innovative capacities will be higher. Suppose family members do not pressure data science professionals regarding professional titles and positions. In that case, data science professionals will learn new knowledge, obtain further information and test new ideas and methods according to their plans and ideas, so their innovative capacities will be more vital. Suppose family members can provide some help when data science professionals need to use some social relations in their work. In that case, their information sources will be more comprehensive, their knowledge will be more expansive, and their thinking will be more divergent so that data science professionals will have more vital innovative abilities(Hedrih).

(10) Organizational factors will affect the data science professionals' families, indirectly affect the innovative capacities of data science professionals, and have the role of intermediary variables on the innovative capacities of data science professionals(Jackson, 2019)**.** The primary time of data science professionals is spent in the university; the rest of the time is spent in the family with their family members, so their family members will perceive the system of the organization will affect the emotions and attitudes of family members so that it will have an impact on the family factors of data science professionals. Organizations that advocate innovation encourage employees to participate in training or further education and learn new knowledge to improve the original innovative capacities of data science professionals; At the same time, encouraging adventure and exploration and tolerating failure within the organization will alleviate the worries of data science professionals about the failure of

original innovation(Van der Lippe & Lipp E Nyi, 2020). These perceptions of data science professionals will communicate with family members, thus affecting the attitude of family members. Family members will show support to get better returns, thus forming a good family atmosphere. If data science professionals think that their innovative achievements will be rewarded with money and welfare benefits will be improved, this perception will encourage data science professionals to collect more information, try to explore their imagination and creativity, these perceptions of data science professionals will communicate with family members, and family members will also perceive their behavior. The attitude and behavior of family members will be influenced, and family members will show their support for their work to repay the family better, thus forming a good family atmosphere. Organizations that advocate innovation encourage employees to participate in training or further education and learn new knowledge to improve data science professionals' original innovative capacities. Encouraging adventure and exploration within the organization and tolerating failure will alleviate the worries of data science professionals about the failure of original innovation, making them more exploratory and willing to explore new theories, new technologies, and new methods. Employees are encouraged to contribute innovative ideas and perspectives regularly. These perceptions of data science professionals will exchange organizational situations with family members. Family members will also perceive their behavior, impacting their attitudes and behaviors. Family members will show more vital work support for the better return of the family. When data science professionals perceive that their efforts will be more rewarded by the organization regarding career development opportunities, their employ ability will be more robust, and the uncertainty of their future will decrease. Therefore, the better the innovation atmosphere of the organization, the more perfect the innovation incentive system, the more career development opportunities provided, and the more remarkable the team-building effect, the better the family atmosphere of data science professionals, the greater the work support provided, and the more conducive to improving the innovative capacities of data science professionals. Therefore, organizational factors positively strengthen the relationship between family factors and data science professionals' innovative capacities(Obrenovic et al., 2020).

(11) Family factors indirectly affect the organization's growth and ultimately affect the innovative capacities of data science professionals and have a moderating effect on the innovative capacities of data science professionals. data science professionals who work in the same university will show different levels of innovative capacities in their work because of the actual performance of family factors(Lewis, 2019). A harmonious and warm family atmosphere helps data science professionals to form good personalities, which makes it easier for them to recognize the excellent qualities advocated by university culture and take this opportunity to enhance their innovative spirit; Family members with relevant professional background help data science professionals develop the habit of actively learning frontier knowledge, which makes them willing to accept and make efficient use of various training opportunities provided by universities, and their innovative quality will also be improved; Rich family conditions make it unnecessary for data science professionals to try their best to support their families, which is also conducive to purifying their work motivation and actively and consciously investing in scientific research work. Similarly, the innovative capacities of data science professionals in the same research team will vary because of the actual performance of family factors. A good family atmosphere can cultivate data science professionals' cheerful, outgoing, and friendly personalities, making them more likely to accept the team atmosphere of mutual assistance and cooperation in teamwork and obey the team's arrangement and deployment of work tasks and schedule. Family members who give the most excellent understanding and support can also make data science professionals devote themselves wholeheartedly to their work.

To sum up, the impact mechanism of various factors on the innovative capacities of Chinese data science professionals can be summarized in Table 5.5.

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Table 5.5 The Mechanism of the Factors Affecting the Innovative Capacities of Data Science Professionals in China

Serial Number	Mechanism of action	
1	The more innovative the data science professionals are, the stronger their innovative capacities is.	
2	The more curiosity, willingness to take risks, perseverance, and other innovative personality of data science professionals, the stronger their innovative capacities.	
3	The more abundant the data science professionals' innovative knowledge reserve is, the stronger their innovative capacities is.	
4	The better the data science professionals perceive the university innovation atmosphere, the more their innovative capacities can be improved.	
5	The more perfect the data science professionals' perceived innovation incentive system is, the more their innovative capacities can be improved.	Direct action
6	The more career development opportunities the university faculty perceived the organization provided, the stronger their innovative capacities was.	
7	The better the team atmosphere, the stronger the cooperation, and the higher the level, the stronger the innovative capacities.	
8	The better the family atmosphere is, the stronger the innovative capacities is.	
9	The greater the job support from family members, the stronger the innovative capacities of data science professionals.	
10	Organizational factors will affect the teacher's family and indirectly affect the innovative capacities of data science professionals.	Mediation
11	Family factors indirectly affect organizations' growth and ultimately affect data science professionals' innovative capacities.	Regulating Action

5.2 Contribution of the Study

The results of this study provide valuable insights into the impact of data science professionals' innovative capacities. These findings have practical significance for universities and educational policymakers in improving the innovative capacities of data

science professionals. The following are some of the main contributions of this study:

(1) Identifying the critical factors of data science professionals' innovative capacities: This study helps to identify the key factors that significantly affect the innovative capacities of data science professionals. By understanding these factors, universities can focus their energies and resources on targeted interventions to support and enhance faculty innovation.

(2) Providing information for professional development plans: The study's results provide information for designing and implementing professional development plans for data science professionals. These programs can incorporate training in innovative teaching methods, technology integration, interdisciplinary collaboration, and other elements identified in the research to foster a culture of innovation among educators.

(3) To provide the basis for university policy-making: This study analyzes the main factors affecting the innovative capacities of data science professionals; data science professionals can develop targeted policies, such as incentive policies, talent introduction policies, and training programs.

(4) Encouraging research on educational innovation: The results may stimulate further research on educational innovation, thus generating more and more knowledge about effective practices and interventions to improve the innovative capacities of data science professionals.

(5) Improving the quality of education: Ultimately, this research contributes to improving the quality of education universities provide. By fostering a culture of innovation among faculty, universities can ensure that students have a more engaging, dynamic, and relevant learning experience.

In conclusion, the findings on the determinants of faculty creativity provide valuable insights that can positively impact universities. By using these findings, universities can take positive measures to cultivate a culture of innovation among faculty members to improve and enhance students' learning outcomes continuously. Continued exploration of these factors will undoubtedly shape the future of education, enabling data science professionals to embrace innovative practices and adapt to the changing educational landscape.

5.3 Limitations of the Study

The author has invested a lot of time and energy in the research process of this paper, striving to be rigorous, scientific, reasonable, and adequate, but due to the limitations of time, ability, and other factors, this study still inevitably has some limitations, mainly reflected in:

5.3.1 Omission of Influencing Factor

Because the literature on the factors affecting the innovative capacities of data science professionals in China is relatively not rich, this study is based on the existing research, using the interview method to verify and supplement, and through brainstorming method to collect a large number of opinions, which are summarized into three aspects: individual factors, organizational factors, and family factors. However, there are many factors influencing the innovative capacities of data science professionals, and there may be other factors that need to be further explored in reality. It needs to be further analyzed in this study.

5.3.2 There May Be Some Errors in the Sample Ran

One is the limitations of Delphi technology itself. Seventeen experts from universities and educational management institutions in Sichuan Province of China participated in the research. Although they have a deeper understanding of higher education, they also have some limitations.

Second, the questionnaire survey sample is mainly from 363 data science professionals in 23 public universities in Sichuan, China. The possible problems of this sample are: 1) from the perspective of industry, it may be single, only considering the education industry itself, but not considering the sociality of education; 2) From the regional point of view, they are all carried out in Sichuan Province of China, which has certain limitations; 3) The sample size is smaller than that of all data science professionals in China.

5.4 Prospects for Future Research

According to some limitations of this study, in future research, more in-depth analysis should be carried out in the following aspects:

(1) Continue to expand the influencing factors. Further access to the latest literature on the innovative capacities of data science professionals and its influencing factors and

broader, more comprehensive, more profound interviews summed up a broader, more applicable system of influencing factors of the innovative capacities of data science professionals.

(2) Continue to expand the sample range. On the one hand, more industries and industries should be included in the scope of the survey; on the other hand, the eastern, central, and western regions should be included in the sampling scope to increase the sample capacity to make the survey's conclusions more general.

(3) Continue to explore countermeasures and suggestions. In the follow-up study, we should pay more attention to the beneficial exploration and creative practice in improving the innovative capacities of data science professionals, make in-depth analysis and induction, and strive to put forward more valuable and universal countermeasures and suggestions in the future.

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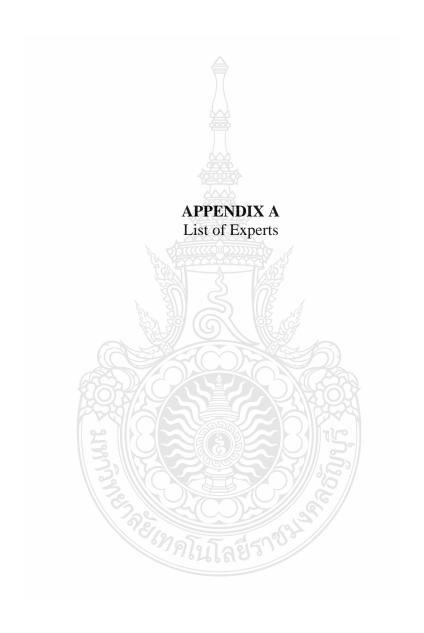
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APPENDIX A
List of Experts

The experts were:

1. Prof. Dr. Honghui Wang，Director of the Academic Committee of Sichuan University of Science＆Engineering

2. Professor. Dr.Yangzhao Cao, Dean of the Academic Affairs Office of Sichuan Provincial Committee of C.P.C

3. Associate Professor Dr. Lei Tang，Director of the Education Department of Sichuan Province

4. Professor. Dr. Guohong Du, HR, Chengdu University of Information Technology

5. Prof. Dr. Yingjie Huang, Dean of the School of Management of Sichuan University of Science＆Engineering

6. Associate Professor Dr. Yuanchun Yu, Associate dean of the school of Management of Sichuan University of Science＆Engineering

7. Professor. Dr.Mingan Gu, teacher of Southwestern University of Finance and Economics

8. Professor. Dr. Chengchun Long, teacher of Sichuan University of Science＆Engineering

9. Professor. Dr.Changcheng Wang,HR, Chengdu University of Technology

10. Professor. Dr.Xianguo Tuo, President of Sichuan University of Science＆Engineering

11. Professor. Dr.Ying Zhou, vice-president，Southwest Petroleum University

12. Prof. Dr. Tang Yuan，department head of the school of management，Sichuan University of Science＆Engineering

13. Professor. Dr.Zhongli Zhou, vice-president（primitive HR）of Chengdu University of Information Technology

14. Professor. Dr.Hua He, Minister of Human Resources of Sichuan Agricultural University

15. Professor. Dr.Tao Jiang, vice-president of Leshan Normal University

16. Professor. Dr.Yi Wan, Dean of the College of Education and Psychology of Sichuan University of Science＆Engineering

17. Associate Professor Dr.Qiongzhu Shen, Deputy Director of the Graduate
Department of Sichuan University of Science＆Engineering

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15 July, 2023

Dear Prof. Dr.Yangzhao Cao. Dean of the Academic Affairs Office of Sichuan Provincial
Committee of C.P.C, China.
Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

  I am writing to request your assistance as an honorary external research reviewer in
evaluating the research instruments of Mr. Zhang Yongfeng, Doctor of Science Program in
Technical Education (Vocational Education) Rajamangala University of Technology
Thanyaburi, who has been working on the dissertation titled "Assessing Factors and Simulating
Innovation: A Study of Innovative Capacities Among Data Science Professionals in China".
under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would
like to request your valuable time to evaluate the research instruments as I strongly believe that
your expertise will be of great value in improving the research instruments.

  If you have any questions or need further information, please feel free to contact Mr.
Zhang Yongfeng on the e-mail: yongfeng_z@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

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MHESI 0908.1/2023

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15 July, 2023

Dear Prof. Dr. Guohong Du. Minister of Human Resources of Chengdu University of
 Information Technology, China.
Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

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      If you have any questions or need further information, please feel free to contact Mr. Zhang Yongfeng on the e-mail: yongfeng_z@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Arnon Niyomphol)
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15 July, 2023

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Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

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If you have any questions or need further information, please feel free to contact Mr. Zhang Yongfeng on the e-mail: yongfeng_z@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

MHESI 0908.3/2023

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023

Dear Prof. Dr. Hua He. Minister of Human Resources of Sichuan Agricultural University, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

　　　I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Zhang Yongfeng, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

　　　If you have any questions or need further information, please feel free to contact Mr. Zhang Yongfeng on the e-mail: yongfeng_z@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

MHESI 0908.4/2023

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023

Dear Prof. Dr.Yingjie Huang. Dean of the School of Management of Sichuan University
of Science & Engineering, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Zhang Yongfeng, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mr. Zhang Yongfeng on the e-mail: yongfeng_z@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Amon Niyomphol)
Dean of Faculty of Technical Education

MHESI 0908.5/2023

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023

Dear Prof. Dr.Tao Jiang. vice-president of Leshan Normal University, China.
Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Zhang Yongfeng, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mr. Zhang Yongfeng on the e-mail: yongfeng_z@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Amon Niyomphol)
Dean of Faculty of Technical Education

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MHESI 0908.6/2023

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023

Dear Prof. Dr.Chengchun Long. Sichuan University of Science & Engineering, China.
Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

  I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Zhang Yongfeng, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

  If you have any questions or need further information, please feel free to contact Mr. Zhang Yongfeng on the e-mail: yongfeng_z@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023

Dear Associate Professor Dr.Qiongzhu Shen. Deputy Director of the Graduate Department of
Sichuan University of Science & Engineering, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Zhang Yongfeng, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mr. Zhang Yongfeng on the e-mail: yongfeng_z@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

MHESI 0908.8/2023

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023

Dear Associate Professor Dr.Lei Tang. Director of the Education Department of Sichuan
Province, China.
Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Zhang Yongfeng, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mr. Zhang Yongfeng on the e-mail: yongfeng_z@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

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MHESI 0908.9/2023

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023

Dear Prof. Dr. Tang Yuan. department head of the school of management, Sichuan
    University of Science & Engineering, China.
Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

        I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Zhang Yongfeng, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

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                                Yours sincerely,

                        (Assistant Professor Arnon Niyomphol)
                        Dean of Faculty of Technical Education

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023

Dear Prof. Dr.Xianguo Tuo. President of Sichuan University of Science & Engineering,
    China.
Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Zhang Yongfeng, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mr. Zhang Yongfeng on the e-mail: yongfeng_z@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

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MHESI 0908.11/2023

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023

Dear Prof. Dr.Yi Wan. Dean of the College of Education and Psychology of Sichuan
    University of Science & Engineering, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

      I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Zhang Yongfeng, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

      If you have any questions or need further information, please feel free to contact Mr. Zhang Yongfeng on the e-mail: yongfeng_z@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

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MHESI 0908.12/2023

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023

Dear Prof. Dr.Changcheng Wang. Minister of Human Resources of Chengdu University
of Technology, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Zhang Yongfeng, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mr. Zhang Yongfeng on the e-mail: yongfeng_z@mail.rmutt.ac.th

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(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

167

MHESI 0908.13/2023

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023

Dear Prof. Wang Honghui. Director of the Academic Committee of Sichuan University of
Science & Engineering, China.

Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Zhang Yongfeng, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

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(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

MHESI 0908.14/2023

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023

Dear Associate Professor Dr. Yuanchun Yu, Associate dean of the school of Management of
    Sichuan University of Science & Engineering, China.
Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

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Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

MHESI 0908.15/2023

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023

Dear Professor. Dr.Ying Zhou. vice-president of Southwest Petroleum University, China.
Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Zhang Yongfeng, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

If you have any questions or need further information, please feel free to contact Mr. Zhang Yongfeng on the e-mail: yongfeng_z@mail.rmutt.ac.th

Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

170

MHESI 0908.16/2023

Office of the Dean, Faculty of Technical Education
Rajamangala University of Technology Thanyaburi
Klong Luang, Pathum Thani 12110 Thailand
Tel:+66-2-549-4710 Fax:+66-2-577-5049

15 July, 2023
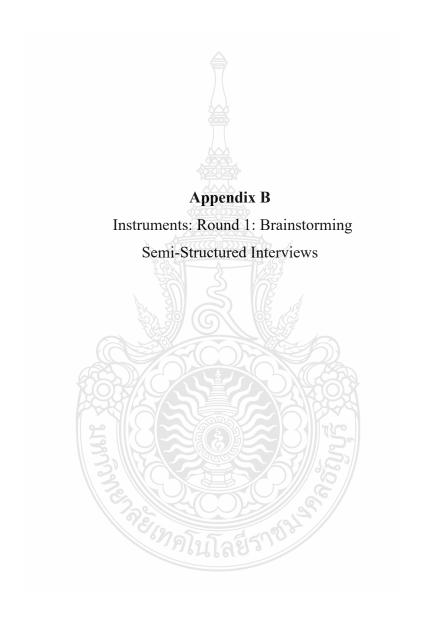
Dear Prof. Professor. Dr.Zhongli Zhou. vice-president（primitive HR）of Chengdu
    University of Information Technology, China.
Subject: Respectfully requesting a letter of invitation of experts for Ph.D. Dissertation

    I am writing to request your assistance as an honorary external research reviewer in evaluating the research instruments of Mr. Zhang Yongfeng, Doctor of Science Program in Technical Education (Vocational Education) Rajamangala University of Technology Thanyaburi, who has been working on the dissertation titled "Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China". under the supervision of Assistant Professor Dr. Thosporn Sangsawang. In this regard, I would like to request your valuable time to evaluate the research instruments as I strongly believe that your expertise will be of great value in improving the research instruments.

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Yours sincerely,

(Assistant Professor Arnon Niyomphol)
Dean of Faculty of Technical Education

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Appendix B

Instruments: Round 1: Brainstorming

Semi-Structured Interviews

Semi-Structured Interviews Question

The semi-structured interview questions are related to the influencing factors of data science professionals' innovative capacities. These influencing factors include three aspects (1) individual factors, (2) school factors, and (3) social and policy factors. To this, experts frame or respond to ideas by commenting. "Please write down any suggestions you have specifically."

1. individual factors
What do you think are the individual factors that affect the innovative capacities of data science professionals? For example: Please selects you to specify any suggestion in the blank.

	1) Have a strong enthusiasm for research work and like to do research
	2) Have a sense of psychological pleasure and be able to concentrate when doing research
	3) Enjoying the research work you do is the most important thing
	4) Enjoy solving problems that are new to me
	5) I think research work can provide me with opportunities to increase my knowledge and skills
	6) Care about the success or failure of research work
	7) Think that doing research work and achieving results can get more economic returns in the future
	8) Believe that doing good research can lead to a good job or easy promotion
	9) Enjoy solving problems that are new to me
	10) Think that doing research can be praised by other students or family members
	11) I care about other people's evaluation of whether my research work can produce social value
	12) Want to improve teaching level through innovation
	13) Improve students' learning experience by designing interactive and immersive learning activities
	14) Promote your academic level through innovation
	15) Participation in innovative research projects, obtaining patents, publications in prestigious journals, or receiving awards and grants for innovative work can enhance their reputation, career prospects, and chances of advancement
	16) Contribute to solving pressing societal challenges through innovation
	17) Establish a cooperative relationship with enterprises to obtain benefits
	18) Improve the reputation of the school through innovative achievements
	19) Satisfy your thirst for knowledge
	20) Bring yourself opportunities for foreign exchanges and cooperation
	21) Adapt to the development of education
	22) Able to contribute valuable ideas to teamwork

	23) Curiosity to explore new things
	24) Able to think independently in research and propose solutions to problems
	25) Able to maintain emotional stability when receiving strong stimuli or under unfavorable conditions
	26) Have a firm will conduct scientific research
	27) Believe in your ability and not easily shaken
	28) Work hard; believe that hard work can make up for one's weakness
	29) feel that they have a great responsibility for innovative research
	30) Open to new ideas, thinking outside the box, and willing to challenge traditional teaching and research methods.
	31) Have a strong curiosity and desire to explore and learn
	32) Strong adaptability, willingness to accept feedback, and willingness to adjust according to the situation
	33) Not afraid of failure and sees setbacks as learning opportunities.
	34) Actively seek opportunities to collaborate with colleagues, industry professionals, and other stakeholders
	35 Strong problem-solving orientation, good at identifying and analyzing challenges or problems.
	36) Actively seek out opportunities to learn and grow
	37) Engage in reflective practice and actively seek feedback from students, colleagues, and peers.
	38) Demonstrate resilience and perseverance in the face of challenges and setbacks
	39) Possesses an innovative vision and is able to inspire and lead others.
	40) can find answers along different lines of thought
	41) Can find valuable and regular problems in general phenomena
	42) Able to understand problems by relying on the representations stored in the mind
	43) Good association and imagination when thinking and solving problems
	44) Can connect disjointed information to achieve epiphanies and momentary breakthroughs
	45) Open to new ideas
	46) Employs creative problem-solving techniques to address challenges and find innovative solutions
	47) Think critically, analyzing situations and information from multiple perspectives
	48) Connecting seemingly unrelated concepts, theories, or areas of knowledge to uncover innovative insights and possibilities
	49) Embrace experimentation and be willing to take calculated risks
	50) Have a future-proof mindset
	51) Systems thinking, seeking holistic and sustainable solutions
	52) Adaptable, able to adapt one's perspectives, methods, and strategies in response to feedback, new information, or changing circumstances to foster innovation
	53) User-centered design thinking, put yourself in the learner's shoes
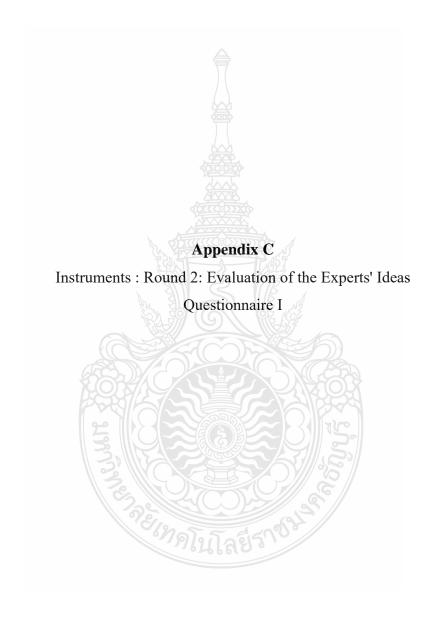
	54) Continuous Learning and Reflection
	55) have broad interdisciplinary knowledge
	56) Rich professional theoretical knowledge and cutting-edge knowledge
	57) Have a systematic grasp of the research methods of this major
	58) Often comment on previous research and identify the advantages and disadvantages
	Stay abreast of the latest research findings, emerging trends, and developments in their fields.
	60) Knowledge of innovative teaching methods and teaching methods
	61) Learn about educational technology tools, applications, and platforms
	62) Proficiency in design thinking methods and creative problem-solving skills
	63) Proficiency in research methods, data analysis, and evaluation techniques
	64) Knowledge of entrepreneurship and innovation ecosystems
	65) Understanding ethical and social considerations in innovation
	66) Cultural and Global Perspective Awareness
	67) Belief in one's teaching ability
	68) Belief in proficiency and depth of knowledge in a particular subject area
	69) Confidence in one's ability to adapt and respond effectively to the diverse needs and characteristics of students
	70) Belief in the ability to create an engaging and motivating learning environment
	71) Belief in classroom management
	72) Belief in the ability to communicate effectively with students, colleagues, and stakeholders
	73) Belief in engaging in continuous professional development and reflective practice
	Job Satisfaction
	74) Degree of satisfaction and participation in teaching activities
	75) Supportive work environment
	76) Autonomy and academic freedom
	77) Participate in academic activities, conduct research, attend conferences, and learn about the latest developments in their fields
	78) Recognition and awards for achievements and contributions
	79) Maintain a healthy work-life balance
	80) Fair and competitive compensation package and benefits
	81) Opportunities for growth and advancement
	82) Relationships with colleagues, management, and support staff
	83) Alignment with personal values and mission
2. organizational factors What do you think are the organizational factors that affect the innovative capacities of data science professionals? For example: Please select your specify any suggestion in the blank.	
	1) Academic rigor

	2) Intellectual stimulation, including intellectual discussion, scholarly debate, and opportunities to explore different perspectives
	3) The school supports research and academic activities
	4) The school encourages collaboration and interdisciplinary interaction among data science professionals, researchers, and students
	5) Learning community, the school encourages a sense of community and mutual support among students, staff, and staff.
	6) Academic freedom, encouraging different viewpoints
	7) Internationalization and global engagement of the school
	8) Supporting infrastructure such as well-equipped libraries, state-of-the-art laboratories and research facilities, technical resources, and administrative support services
	9) Academic ethics and integrity
	10) The school values continuous learning and professional development of staff and students
	11) Respect Diversity and Inclusion
	12) Mentoring and support, including a mentoring culture
	13) The scientific research platform provides data science professionals with a wide range of research resources, including databases, journals, research tools, and equipment
	14) Collaboration and networking, where faculty can connect with colleagues with similar research interests, initiate interdisciplinary collaborations, and participate in joint research projects
	15) Research grants and grants
	16) Provide advanced research tools, software, and infrastructure
	17) Provide training programs and workshops to support faculty in research methods, data analysis, grant writing, and publication skills
	18) Provide faculty with the opportunity to publish their research in reputed journals and conferences
	19) Research platform construction promotes the integration of scientific research and teaching
	20) Engage in research through the scientific research platform to provide data science professionals with continuous professional development opportunities
	21) The school invests in the construction of a scientific research platform, which reflects the organization's recognition and support for scientific research activities
	22) data science professionals participate in research through the scientific research platform, which contributes to the progress of knowledge in their respective fields
	23) Student evaluation of teaching
	24) Peer Reviews
	25) Self-assessment and reflection
	26) Teaching files
	27) Classroom Observation

	28) Assessment of Student Learning Outcomes
	29) data science professionals' participation in teaching-related professional development activities
	30) Peer Review Board Evaluation
	31) Integration with promotion and tenure processes
	32) Research Laboratory
	33) Technology and Innovation Center
	34) High-performance computing (HPC) facilities
	35) Virtual Reality (VR) and Augmented Reality (AR) Lab
	36) Fabrication Labs and Makerspaces
	37) Data Analysis and Visualization Resources
	38) Cloud Computing and Storage Services
	39) Technology Transfer Office
	40) Innovation Funding and Grants
	41) Technical support service
	42) Provide opportunities for further study
	43) Research and scholarship programs
	44) Executive Education and Continuing Professional Development
	45) Study abroad and exchange programs
	46) Online and distance learning courses
	47) Interdisciplinary courses
	48) Opportunities to enter the enterprise to enrich practice and exercise

Please write your specify any suggestion.

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3. Family Factors
What do you think are the family factors that affect the innovative capacities of data science professionals? For example: Please select your specify any suggestion in the blank.

	1) Have good communication with family members
	2) Mutual trust among family members
	3) Create a good family atmosphere through love and emotional expression
	4)Mutual respect among family members
	5) Have a good parenting style for children
	6) Able to resolve family conflicts reasonably
	7) Shared responsibilities among family members
	8)Good emotional support among family members
	9) shared cultural and religious influences
	10) Ability to spend time with family members
	14) Offer words of encouragement and celebrate each other's achievements
	15) Actively listen to family members' work challenges, successes and concerns

	16) Demonstrate empathy and understanding for the work of family members
	17) Be flexible with your schedule and accommodate work-related commitments
	18) Actively share family responsibilities
	19) Celebrate milestones, such as promotions, awards, or major projects
	20) Provide constructive feedback on the work of family members
	21) Financial support where appropriate and feasible
	22) Work together to solve problems in work and life
	23) Respect the career choices of family members
	24) Respect each other's work-related boundaries
	25) Promote work-life balance, mutual encouragement and support
	26) Share knowledge and skills among family members
	27) Be each other's cheerleaders, offering unwavering support and motivation

Please write your specify any suggestion.

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Appendix C

Instruments : Round 2: Evaluation of the Experts' Ideas

Questionnaire I

Faculty of Technical Education
Rajamangala University of Technology Thanyaburi (RMUTT)
39 Moo 1, Rangsit-Nakhon Nayok Road
Klong Hok, Khlong Luang, Pathum Thani
Postal Code 12110, Thailand
Date: ………………………………………….……………………

Dear …………………………………………………………….

My name is Mr. Zhang Yongfeng. The researcher is a Ph.D. student in the Vocational Education Program in the Faculty of Technical Education of the Rajamangala University of Technology Thanyaburi, RMUTT. The research working on The dissertation entitled: *Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China.* The research is in the process of developing the research tools and collecting the data. Seventeen experts will be interviewed in four rounds to collect data using the Delphi technique. First, semi-structured interviews were employed, and data were analyzed using content analysis. Then the results were used to develop the rating scale questionnaires, which will be used for collecting data in the second and third rounds. The second and third rounds aim to confirm the opinions and answers provided by those experts to explore the conclusions and the agreement among experts. These are very important factors for analyzing the innovative capacities of Chinese data science professionals, and provide help for further discussion on improving the innovative capacities of data science professionals.

This questionnaire was constructed based on the content analysis of the first round. As a result, all experts are kindly asked to please answer the questionnaire. The data obtained will be analyzed by median, mode, and interquartile range. The opinions and answers will be kept secret, and the results will be reported as a whole group.

To respond appropriately to the questionnaire, consider and provide the numbers *1, 2, 3, 4,* and *5* to each item for approval, while five is the highest and one is the lowest.

Thank you very much for your kind co-operation.

Yours sincerely,
Mr. Zhang Yongfeng

Questionnaire I on

Influencing Factors of data science professionals ' innovative capacities in China

Instructions :
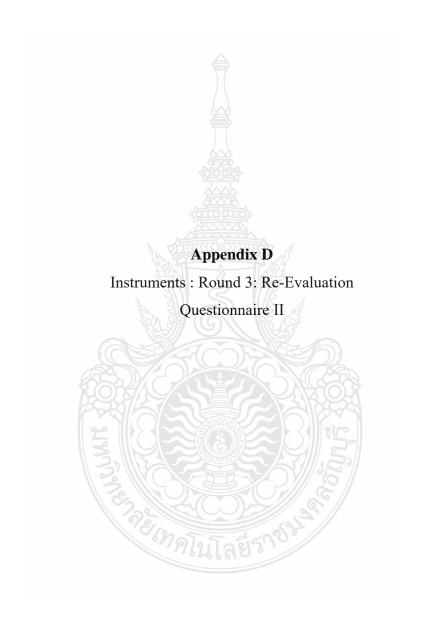
1) Please tick (/) in each blank according to your level of opinion. 5 is very important, 4 is important, 3 is general, 2 is not important, and 1 is very unimportant.

2) If you think the impact of each aspect needs to be further improved, please fill in your answer, thank you very much.

individual factors						
Influencing factors		View				
		5	4	3	2	1
1. Innovative thinking	1) Able to see the multi-faceted aspects of the problem and think about the problem from multiple angles					
	2) Like to seek different perspectives					
	3) Explore and study the incredible connections between things					
	4) have rich imagination					
	5) Be willing to make problem assumptions and seize opportunities for change					
	6) Connect seemingly unrelated concepts, theories, or areas of knowledge					
	7) Willingness to try new ideas and approaches					
2. Innovative personality	8) Curiosity, desire to explore and learn					
	9) Be creative, open to new ideas, and think outside the box					
	10) The approach of data science professionals is adaptable and flexible					
	11) Dare to take risks and not be afraid of failure					
	12) Resilience, showing perseverance in the face of challenges and setbacks					
3. Innovation knowledge	13) Have rich subject expertise to lay the foundation for innovation					
	14) Willingness to learn about the latest research results, emerging trends and developments in the research field					
	15) Have an interdisciplinary perspective and be able to integrate different perspectives to promote innovation					
	16) Proficiency in research methods, data analysis and evaluation techniques					

Additional advice for individual factors:						

organizational factors						
Influencing factors		View				
		5	4	3	2	1
1. Organizational atmosphere	1) The school encourages data science professionals to actively learn					
	2) Schools tolerate teacher failure					
	3) The school encourages data science professionals to come up with new ideas					
	4) Schools encourage data science professionals to implement new perspectives					
	5) The school publicly praises innovators who have achieved innovative results					
	6) School leaders have a strong sense of innovation					
	7) School leaders dare to take innovative risks					
	8) School leaders support innovative activities and trust innovators					
2. Incentives for innovation	9) Schools give innovators monetary rewards and benefits					
	10) The school honors or commends innovators					
3. Career Development	11) Schools provide more training opportunities for innovators					
	12) Schools give innovators more opportunities to advance					
4. Team building	13) data science professionals have clear unity goals and clear assessment standards					
	14) The members of the team brainstorm, work and goals are related					
	15) Team members supervise each other and agree with each other					
	16) Team members share resources and encourage each other					
Additional suggestions for organizational factors:						

family factors						
Influencing factors		View				
		5	4	3	2	1
1. Family atmosphere	1) The family atmosphere is harmonious and the life is warm					
	2) The family's financial pressure is not great					
	3) Family members understand work and give more support for housework					
2. Job support	4) Family members can handle various conflicts better					
	5) When encountering work difficulties, family members can give reasonable suggestions					
	6) Family members do not give pressure on job titles and job development					
	7) Family members can use social relationships to provide work help for themselves					
Additional advice on family factors:						

Thank you very much for taking part in this questionnaire in your busy schedule. Later, our research team will analyze all the questionnaires and provide the participants with the research report of this questionnaire, showing the average situation of data science professionals' research team in scientific research abil the city and academic development. This is the end of the questionnaire. Thank you again for taking part in this questionnaire survey!

Appendix D

Instruments : Round 3: Re-Evaluation

Questionnaire II

Faculty of Technical Education
Rajamangala University of Technology Thanyaburi (RMUTT)
39 Moo 1, Rangsit-Nakhon Nayok Road
Klong Hok, Khlong Luang, Pathum Thani
Postal Code 12110, Thailand
Date: ……………………………………….……………………

Dear …………………………………………………………….

My name is Mr. Zhang Yongfeng. The researcher is a Ph.D. student in the Vocational Education Program in the Faculty of Technical Education of the Rajamangala University of Technology Thanyaburi, RMUTT. The research working on The dissertation entitled: *Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China.* The research is in the process of developing the research tools and collecting the data. Seventeen experts will be interviewed in four rounds to collect data using the Delphi technique. First, semi-structured interviews were employed, and data were analyzed using content analysis. Then the results were used to develop the rating scale questionnaires, which will be used for collecting data in the second and third rounds. The second and third rounds aim to confirm the opinions and answers provided by those experts to explore the conclusions and the agreement among experts. These are very important factors for analyzing the innovative capacities of Chinese data science professionals, and provide help for further discussion on improving the innovative capacities of data science professionals.

This questionnaire was constructed based on the content analysis of the first round. As a result, all experts are kindly asked to please answer the questionnaire. The data obtained will be analyzed by median, mode, and interquartile range. The opinions and answers will be kept secret, and the results will be reported as a whole group.

To respond appropriately to the questionnaire, consider and provide the numbers *1, 2, 3, 4,* and *5* to each item for approval, while five is the highest and one is the lowest.

Thank you very much for your kind co-operation.

Yours sincerely,
M r . Zhang Yongfeng

Questionnaire II on

Influencing Factors of data science professionals' innovative capacities in China

Instructions :

1) Please tick (/) in each blank according to your level of opinion.

2) If you think the impact of each aspect needs to be further improved, please fill in your answer, thank you very much.

individual factors						
Influencing factors		View				
		5	4	3	2	1
n1. Innovative thinking	1) Able to see the multi-faceted aspects of the problem and think about the problem from multiple angles					
	2) Like to seek different perspectives					
	3) Explore and study the incredible connections between things					
	4) have rich imagination					
	5) Be willing to make problem assumptions and seize opportunities for change					
	6) Willingness to try new ideas and approaches					
2. Innovative personality	7) Curiosity, desire to explore and learn					
	8) Be creative, open to new ideas, think outside the box					
	9) Dare to take risks and not be afraid of failure					
	10) Resilience, showing perseverance in the face of challenges and setbacks					
3. Innovation knowledge	11) Have rich subject expertise to lay the foundation for innovation					
	12) Willingness to learn about the latest research results, emerging trends and developments in the research field					
	13) Have an interdisciplinary perspective and be able to integrate different perspectives to promote innovation					
	14) Proficiency in research methods, data analysis and evaluation techniques					

Other suggestions for individual factors:

organizational factors							
Influencing factors		View					
		5	4	3	2	1	
1. Organizational atmosphere	1) The school encourages data science professionals to actively learn						
	2) Schools tolerate teacher failure						
	3) The school encourages data science professionals to come up with new ideas and can implement them						
	4) The school publicly praises innovators who have achieved innovative results						
	5) School leaders have a strong sense of innovation						
	6) School leaders dare to take innovative risks						
	7) School leaders support innovative activities and trust innovators						
2. Incentives for innovation	8) Schools give innovators monetary rewards and benefits						
	9) The school honors or commends innovators						
3. Career Development	10) Schools provide more training opportunities for innovators						
	11) Schools give innovators more opportunities to advance						
4. Team building	12) data science professionals have clear unity goals and clear assessment standards						
	13) The members of the team brainstorm, work and goals are related						
	14) Team members supervise each other and agree with each other						
	15) Team members share resources and encourage each other						

Additional suggestions for organizational factors:

family factors						
Influencing factors		View				
		5	4	3	2	1
1. Family atmosphere	1) The family atmosphere is harmonious and the life is warm					
	2) The family's financial pressure is not great					
	3) Family members understand work and give more support for housework					
2. Job support	4) Family members can handle various conflicts better					
	5) When encountering work difficulties, family members can give reasonable suggestions					
	6) Family members do not give pressure on job titles and job development					
	7) Family members can use social relationships to provide work help for themselves					
	8) Give data science professionals more independent working space					
Additional advice on family factors:						

Appendix E

Instruments : Round 4: Resolved and Reported

Questionnaire III

Faculty of Technical Education
Rajamangala University of Technology Thanyaburi (RMUTT)
39 Moo 1, Rangsit-Nakhon Nayok Road
Klong Hok, Khlong Luang, Pathum Thani
Postal Code 12110, Thailand
Date: ………………………………………….……………………

Dear …………………………………………………………….

My name is Mr. Zhang Yongfeng. The researcher is a Ph.D. student in the Vocational Education Program in the Faculty of Technical Education of the Rajamangala University of Technology Thanyaburi, RMUTT. The research working on The dissertation entitled: *Assessing Factors and Simulating Innovation: A Study of Innovative Capacities Among Data Science Professionals in China.* The research is in the process of developing the research tools and collecting the data. Seventeen experts will be interviewed in four rounds to collect data using the Delphi technique. First, semi-structured interviews were employed, and data were analyzed using content analysis. Then the results were used to develop the rating scale questionnaires, which will be used for collecting data in the second and third rounds. The second and third rounds aim to confirm the opinions and answers provided by those experts to explore the conclusions and the agreement among experts. These are very important factors for analyzing the innovative capacities of Chinese data science professionals, and provide help for further discussion on improving the innovative capacities of data science professionals.

This questionnaire was constructed based on the content analysis of the first round. As a result, all experts are kindly asked to please answer the questionnaire. The data obtained will be analyzed by median, mode, and interquartile range. The opinions and answers will be kept secret, and the results will be reported as a whole group.

Instructors' opinion concerning Influencing Factors of Chinese data science professionals' innovative capacities.

Thank you very much for your kind co-operation.

Yours sincerely,
M r . Zhang Yongfeng

Questionnaire III on
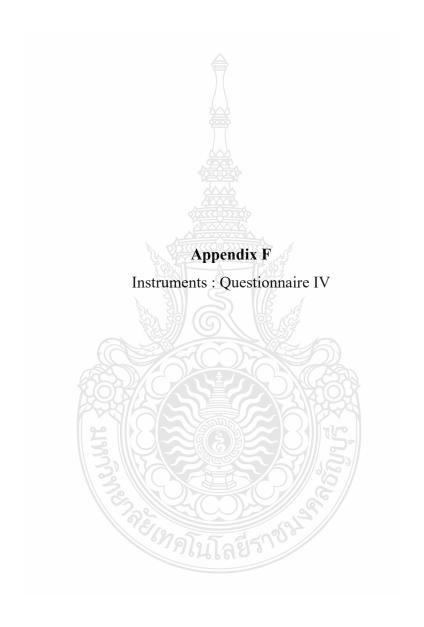
Influencing Factors of data science professionals ' innovative capacities in China

Instructors' opinion concerning Influencing Factors of Chinese data science professionals' innovative capacities

	Influencing factors	Confirmation (Percentage)	Dis-confirmation (Percentage)	Reject (Percentage)
Innovative thinking	1) Able to see the multi-faceted aspects of the problem and think about the problem from multiple angles			
	2) Like to seek different perspectives			
	3) Explore and study the incredible connections between things			
	4) have rich imagination			
	5) Be willing to make problem assumptions and seize opportunities for change			
	6) Willingness to try new ideas and approaches			
Innovative personality	7) Curiosity, desire to explore and learn			
	8) Be creative, open to new ideas, think outside the box			
	9) Dare to take risks and not be afraid of failure			
	10) Resilience, showing perseverance in the face of challenges and setbacks			
Innovation knowledge	11) Have rich subject expertise to lay the foundation for innovation			
	12) Willingness to learn about the latest research results, emerging trends and developments in the research field			

	13) Have an interdisciplinary perspective and be able to integrate different perspectives to promote innovation			
	14) Proficiency in research methods, data analysis and evaluation techniques			
Organizational atmosphere	1) The school encourages data science professionals to actively learn			
	2) Schools tolerate teacher failure			
	3) The school encourages data science professionals to come up with new ideas and can implement them			
	4) The school publicly praises innovators who have achieved innovative results			
	5) School leaders have a strong sense of innovation			
	6) School leaders dare to take innovative risks			
	7) School leaders support innovative activities and trust innovators			
Incentives for innovation	8) Schools give innovators monetary rewards and benefits			
	9) The school honors or commends innovators			
Career Development	10) Schools provide more training opportunities for innovators			
	11) Schools give innovators more opportunities to advance			
Team building	12) data science professionals have clear unity goals and clear assessment standards			

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	13) The members of the team brainstorm, work and goals are related			
	14) Team members supervise each other and agree with each other			
	15) Team members share resources and encourage each other			
Family atmosphere	1) The family atmosphere is harmonious and the life is warm			
	2) The family's financial pressure is not great			
	3) Family members understand work and give more support for housework			
Job support	4) Family members can handle various conflicts better			
	5) When encountering work difficulties, family members can give reasonable suggestions			
	6) Family members do not give pressure on job titles and job development			
	7) Family members can use social relationships to provide work help for themselves			
	8) Give data science professionals more independent working space			

Appendix F

Instruments : Questionnaire IV

<p style="text-align: center;">Questionnaire IV on</p>
<p style="text-align: center;">Influencing Factors of data science professionals ' innovative capacities in China</p>

Dear teacher,

We are researching the factors affecting Chinese data science professionals' innovative capacities. Thank you very much for taking time out of your busy schedule. Fill in the consultation questionnaire about Influencing Factors of data science professionals' innovative capacities in China.

This study preliminarily constructs the factors affecting the innovative capacities of Chinese data science professionals, including individual factors, organizational factors, and family factors. It evaluates the innovative capacities of Chinese data science professionals mainly from the aspects of teaching innovation, scientific research innovation, and social service innovation. Please assess this indicator according to your understanding and experience, where 5 = strongly agree (or very important), 4 = relatively agree (or rather important), 3 = neutral (or general), 2 = moderately disagree (or not important), and 1 = strongly disagree (or very not important). The consultation results only apply to this academic research, and we will keep the information and evaluation results of the questionnaire strictly confidential.

1. Personal Basic Information

(1) Your gender: male □   female □

(2) Your age is: 20-30 □   31-40 □   41-50 □ 51-60□

(3) The nature of your research: primary research □   applied research □

(4) Your professional title is: Junior □ Intermediate □Deputy Senior □Senior □

(5) Your education level is: Below undergraduate level □ undergraduate□

<p style="text-align: center;">Master □   Doctor □</p>

2. The Influencing Factors of Chinese data science professionals' innovative capacities

(1)individual factors		View				
Influencing factors		5	4	3	2	1
Innovative thinking	1) Able to see the multi-faceted aspects of the problem and think about the problem from multiple angles					
	2) Like to seek different perspectives					
	3) Explore and study the incredible connections between things					
	4) have a rich imagination					
	5) Be willing to make problem assumptions and seize opportunities for change					
	6) Willingness to try new ideas and approaches					
	7) Curiosity, desire to explore and learn					

Innovative personality	8) Be creative, open to new ideas, think outside the box					
	9) Dare to take risks and not be afraid of failure					
	10) Resilience, showing perseverance in the face of challenges and setbacks					
Innovation knowledge	11) Have rich subject expertise to lay the foundation for innovation					
	12) Willingness to learn about the latest research results, emerging trends, and developments in the research field					
	13) Have an interdisciplinary perspective and be able to integrate different perspectives to promote innovation					
	14) Proficiency in research methods, data analysis, and evaluation techniques					

(1)organizational factors

Influencing factors		View				
		5	4	3	2	1
Organizational atmosphere	1) The school encourages data science professionals to learn actively					
	2) Schools tolerate teacher failure					
	3) The school encourages data science professionals to come up with new ideas and can implement them					
	4) The school publicly praises innovators who have achieved innovative results					
	5) School leaders have a strong sense of innovation					
	6) School leaders dare to take innovative risks					
	7) School leaders support innovative activities and trust innovators					
Incentives for innovation	8) Schools give innovators monetary rewards and benefits					
	9) The school honors or commends innovators					
Career Development	10) Schools provide more training opportunities for innovators					
	11) Schools give innovators more opportunities to advance					
Team building	12) data science professionals have clear unity goals and clear assessment standards					
	13) The members of the team brainstorm, work, and goals are related					
	14) Team members supervise each other and agree with each other					

	15) Team members share resources and encourage each other					

(3) Family factors

Influencing factors		View				
		5	4	3	2	1
Family atmosphere	1) The family atmosphere is harmonious, and life is warm					
	2) The family's financial pressure is not great					
	3) Family members understand work and give more support for housework					
Job support	4) Family members can handle various conflicts better					
	5) When encountering work difficulties, family members can give reasonable suggestions					
	6) Family members do not put pressure on job titles and job development					
	7) Family members can use social relationships to provide work help for themselves					
	8) Give data science professionals more independent working space.					

3. **The Evaluation Criteria of Chinese data science professionals' innovative capacities**

teaching innovation	1)Innovation can enhance the teaching experience through technology integration					
	2)Innovation Can Enrich Active Learning Strategies					
	3)Innovation can perfect the flipped classroom model					
	4)Innovation Can Boost Project-Based Learning					
	5)Innovation Can Boost Inclusive Teaching Practices					
	6)Innovation Facilitates Personalized Learning Paths					
technological innovation	1)Scientific research can lead to the identification of new phenomena, processes, or relationships					
	2)Innovation can deposit discoveries and reveal new phenomena					
	3)Innovation can drive technological progress					

	4)Innovation can drive improvements in research methods					
	5)Beds can boost tech commercialization					
	6)Innovation Can Facilitate Paradigm Shifts					
	7)Innovation can foster interdisciplinary collaboration					
social service innovation	1)Innovation can facilitate community-engaged research that addresses specific needs and challenges					
	2)Innovation Can Boost Social Entrepreneurship Projects					
	3)Innovation can make better service-learning programs					
	4)Innovation can promote the development of innovation centers and incubators					
	5)Innovation can advance policy research and advocacy					
	6)Innovation can enhance capacity building and training					
	7)Innovative technology can benefit society					

Biography

Name-Surname	Mr. Yongfeng Zhang
Date of Birth	May 8, 1977
Address	519 Huixing Road, Ziliujing District, Zigong City, Sichuan Province, China
Education	Master, Public Administration
Work Experience	Huaguang Ceramics Co., Ltd. (1999.07-2001.12) Sichuan University of Science & Engineering(2002.01-present)
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