DEVELOPMENT OF MANAGEMENT MODEL FOR INNOVATION PLATFORM IN MEDICAL ARTIFICIAL INTELLIGENCE INDUSTRY

TANG YUYING

A thesis submitted in partial fulfillment of the requirements for Doctor of Philosophy Program in Technology and Innovation Management

Academic Year 2023

Thesis Title Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry

Author Miss Tang Yuying

Thesis Committee

..... Chairperson
(Associate Professor Dr.Natdanai Singkhleewon)

..... Committee
(Associate Professor Dr. Sombat Teekasap)

..... Committee
(Dr.Sirigarn Phokheaw)

Accepted by Bansomdejchaopraya Rajabhat University in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in Technology and Innovation Management

..... Dean of Graduate School
(Assistant Professor Dr. Nukul Sarawong)

..... President
(Assistant Professor Dr. Kanakorn Sawangcharoen)

Defense Committee

..... Chairperson
(Associate Professor Dr. Piyabutr Wanichpongpan)

..... Committee
(Assistant Professor Dr.Settachai Chaisanit)

..... Committee
(Dr.Watchara Sroykham)

Title	**Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry**
Author	**Tang Yuying**
Program	**Technology and innovation Management**
Major Advisor	**Assoc. Prof. Dr. Nutdanai Singkhleewon**
Co-advisor	**Assoc. Prof. Dr. Sombat Teekasap**
Co-advisor	**Dr. Sirigarn Phokheaw**
Academic Year	**2023**

ABSTRACT

This study aims to develop an innovation platform management model to address issues in medical AI Industry and promote its future development. The first step is to analyze the existing problems, opportunities and innovative solutions in the medical AI industry by literature analysis and in-depth interview with five experts. The second step is to evaluate the consistency of innovation platform management elements for the medical AI industry by expert confirmation process with 17 experts. The final step is to create the innovation platform management model and confirm by 5 experts.

The findings of this study are as follows: (1) It identified 5 aspects, 11 themes and 35 elements for innovation platform management in medical AI industry. Experts agree on the necessity of a multi-faceted approach to foster innovation, emphasizing the importance of data privacy, domain knowledge base development, interdisciplinary talent cultivation, clinical-AI integration, organizational management. (2) The proposed management model presents a comprehensive framework encompassing five aspects: infrastructure management, technology innovation management, application scenarios management, policy and regulation management, and platform organization management. This study emphasizes the importance of stakeholder collaboration and the utilization of the innovation platform to facilitate the industry development.

Keywords: Management Model, Innovation Platform, Medical Artificial Intelligence, Platform Empowerment

Acknowledgement

On the occasion of completing this paper, I deeply feel that I am standing on the shoulders of giants, receiving help and support from countless people. I would like to express my sincerest gratitude to all those who have provided me with help and care in my academic journey.

Firstly, I would like to express my special gratitude to my three esteemed advisors Assoc Prof. Dr. Nutdanai Singkhleewon, Assoc Prof. Dr. Sombat Teekasap and Dr. Sirigarn Phokheaw. During the writing process of my paper, you provided me with meticulous guidance with a rigorous academic attitude, profound professional skills, and keen insight, which enabled me to continuously make progress in academia. Dr. Nutdanai just like an elder brother, tirelessly teaching and patiently urging me to refine and finalized my paper. Dr. Sombat, with his loving elder's wisdom, not only provided extremely valuable guidance in academic papers, but also broadened my understanding of Thai culture with his open and inclusive mindset. Dr. Sirigan, is like a caring sister, was always ready to lend a helping hand and offer unwavering support. What particularly moved me was that during my time studying in Thailand, I fell ill and Dr. Nutdanai personally accompanied me to the hospital, showing immense concern. Dr. Sombat assisted in the publication process of my paper while expressed great concern for my well-being. Dr Sirigan was also very concerned about my health when i was in the hospital. All your concern and encouragement have made me feel warm and strength. I express my deepest respect and gratitude to you.

Here, I also would like to express my special thanks to Assoc. Prof. Dr. Nukul Sarawong. He has extended a lot of help to me, just as he has to his other students. His dedication to his subject and his prompt and responsive attitude towards academics have profoundly inspired me. His guidance has been invaluable in my academic journey, and I am deeply grateful for all the assistance he has provided.

Secondly, I would like to thank my classmates, such as Feng Jun, Zhang Ke, Huang Jian, and Liu Yanbo. In academia, we discuss problems together, share research results, and the help and support between us have greatly benefited me. Although we haven't been studying together for a long time, your friendship is a precious treasure in my life, and I will cherish it forever.

Finally, I would like to thank the experts who provided support during the research process of the paper. Your selfless dedication has helped me with my research data. Your professionalism has given me a deeper understanding of academic research. Here, I would like to express my heartfelt gratitude and highest respect to you.

In short, the completion of this paper is inseparable from the help and support of numerous people. Here, I once again express my heartfelt gratitude to all those who care, help, and support me!

Tang Yuying

Contents

Contents (Continued)

List of Figures

List of Tables

Chapter 1
Introduction

Rationale

Artificial intelligence (hereafter referred to as AI) has brought profound changes to the medical field with its advanced data processing and optimization abilities (Sun, Gao & Wu, 2021). Recognized for its heightened intelligence and adept problem-solving skills (Duan, Edwards & Dwivedi, 2019), AI is effectively utilized in a variety of medical application contexts. The field of medical AI has garnered significant attention in recent years, showing enormous potential for growth and development.

However, integrating AI and the medical industry remains challenging, such as inexplicable diagnosis results (Liu & Wang, 2020), not fully guaranteed medical safety, difficulties in forming service loop and workload of doctors, which requires deep cooperation between AI and medical experts. Due to the current limitations in the maturity of AI technology and its applications in the medical field, the vast majority of medical AI enterprises have not yet achieved profitability and are under great pressure of development (Luo, 2021).

In order to promote the application and development of industrial intelligence in all walks of life, the Chinese government has introduced a series of policies to promote the construction of innovation platforms. The science and technology Innovation platform is constructed as basic support for the development of medical AI industry, with its synergy of AI software, hardware and intelligent cloud. Innovation platforms led by well-known technology giants and led by government have emerged to carry out technology innovation and provide open sharing services. They integrate platform resources to facilitate industrial development, enabling them to tackle increasingly complex science and technology innovation tasks through interdisciplinary collaboration and integration (Hao, 2021).

However, with the deep integration of AI and medical industry, the demand for innovation platforms is increasingly complex. The science and technology innovation platform need to explore new models and integrate new resources to

provide better innovative solutions. Developing a management model suitable for the future development demands of the medical AI industry has become an urgent task.

Most of the researches on the management model of innovation platforms are conducted from the perspective of platform empowerment, based on resource concepts, resource dependency theories, and knowledge concepts. Some have discussed the process and mechanism of innovation platform empowerment to promote the optimization of resource allocation from the perspective of mechanism design (Zhou & He, 2021), and some have studied the impact of platform empowerment on customer value co creation from the perspective of integration analysis (Chen, 2021).

However, there is a dearth of research on the multi-levels empowerment role of the innovation platform and the organic relationships of various industry stakeholders under the platform empowerment. The innovation platform and the various industry stakeholders are in a state of co-existence from an ecological perspective. Therefore, there is also a lack of mature theoretical systems and models for how this symbiotic relationship can facilitate the development of the medical AI industry under platform empowerment.

In response to the above theoretical gaps, this study adopts the in-depth interview based on literature analysis to analyze the problems and opportunities faced by the development of the medical AI industry, and a expert panel to evaluate the consistent of elements of innovation platform management for the medical AI industry, creating and evaluate the innovation platform management model. The purpose of this research is to develop an innovation platform management model required for the future development of the medical AI industry. Specifically, it seeks to explore the key factors that contribute to successful innovation in this field, and to identify the best management practices and guidelines that are most effective in supporting such innovation.

Research Question

What is the appropriate management model for the innovation platform to facilitate the future development of medical artificial intelligence Industry?

Research Objective

1. Main objective

To develop management model for innovation platform in medical artificial intelligence industry

2. Specific Objectives

2.1 To analyze the existing problems, opportunities and innovative solutions in the medical artificial intelligence industry.

2.2 To evaluate the consistency of innovation platform management elements for the medical artificial intelligence industry.

2.3 To create and confirm the innovation platform management model for the future development of the medical artificial intelligence industry

Scope of the Research

Population

Stakeholders in the medical AI industry, including universities and research institutions, medical AI enterprises, hospitals, and investment institutions.

Sample group

This study intents to select 5 experts from the population for in-depth interview, 17 experts for elements evaluation and 5 experts for model confirmation, using the snowball sampling method based on the following criteria, 1) has a bachelor degree or above in education; 2) at least 5 years of work experience in medical AI or related field; 3) considering that diversity of knowledge and position can provide different perspectives, experts come from different stakeholders in the medical AI industry.

Variables

Dependent Variable: Innovation Platform Management Model for Medical AI Industry

Independent Variable: Infrastructure, Technology Innovation, Application Scenario, Policies and Regulations, Platform Organization

Advantages

1. The research area is to develop an innovation platform management model for the medical AI industry, which is relatively novel and belongs to an undeveloped area.

2. The research approach adopts a combination of in-depth interview and expert confirmation process, selecting industry stakeholders for problem probing and model evaluation, which is different from the current research approach in the industry.

3. Starting from the current research status and challenges of the development of the medical AI industry, the research content analyzes the managements element and create the management mode of innovative platforms, which is more closely related to solving practical problems.

Definition of Terms

Medical AI

It refers to that AI technology and medical industry are integrated, developed, and applied to different medical scenarios such as biotechnology, medical image diagnosis, drug research and development, auxiliary diagnosis, disease diagnosis and treatment, bringing profound changes to the medical field.

Innovation Platform

It refers to a development platform with structural and institutional arrangements led by enterprises or government, aiming to improve the ability and efficiency of scientific and technological innovation, and play a fundamental and leading role in innovation development.

Infrastructure

It refers to long-term engineering construction, equipment, facilities, and services provided for economic production. Based the three elements of AI, data, computing, and algorithms constitute the core infrastructure of AI, as well as the infrastructure of the digital economy.

Technology Innovation

It refers to the innovation of production technology, including the development of new technologies, or the application of existing technologies. The

former such as the creation of a new laser technology, and the latter such as the development of a new product or new service based on existing laser technology.

Application Scenario

It refers to the "most likely" scenario for a user when a medical AI application or product is used. Scenarios include multiple aspects such as time, space, device support, social interaction, and user emotions.

Clinical Application

It refers to the process of applying medical knowledge, skills, and methods to clinical practice to solve problems such as disease diagnosis, treatment, and nursing. It involves multiple fields such as clinical medicine, clinical nursing, and clinical pharmacy.

Industrial Policies

It refers to the sum of various policies that the government intervenes in the formation and development of industries in order to achieve certain economic and social goals. Their main functions are to remedy market defects, effectively allocate resources, and ensure sustainable economic development.

Platform organization

It refers to an organization with multi-subject participation, which empowers members on the platform through resource aggregation and open sharing mechanisms, so that they can organize various resources in flexible forms and form products, services, and solutions.

Platform Empowerment

It refers to the innovation platform that gathers industrial resources, innovative technologies, ecosystems, etc., and provides key grasp and new service tools for industrial upgrading and innovative development.

Industrial Symbiosis

It refers to the formation of symbiotic relationship between different enterprises through establishing some kind of connection, improving resource sharing and rational utilization, promoting industrial co evolution, and enhancing the viability and profitability of enterprises.

Industrial Ecology

It refers to a multi-dimensional open system similar to the natural ecosystem and interdependent and symbiotic among multiple subjects. It follows the principle

of dissipative structure, and its material flow and energy flow are utilized at multiple levels as much as possible to reduce the entropy of the system, so as to achieve a virtuous cycle and realize the coordinated development of industry and environment.

Management Model

It refers to a set of operating systems solidified in the management process from a specific management concept, which can be expressed by the formula: management concept, system structure and management elements.

Research Framework

The research framework of this study is structured to provide a clear path from identifying the management elements to developing and confirming a management model. It is summarized as shown in Figure 1.1.

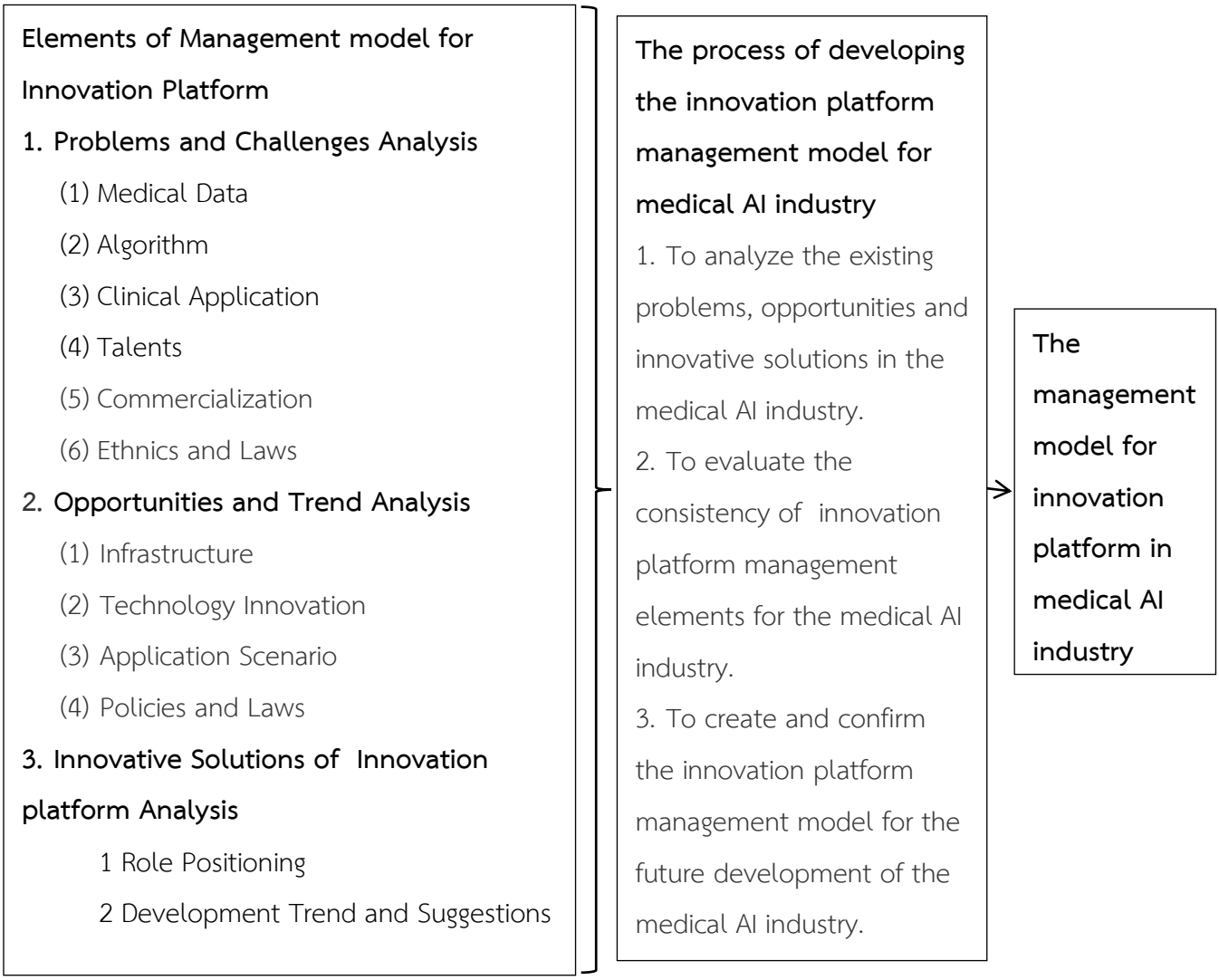


Figure 1.1 Research Framework

Chapter 2

Literature Review

As one of the important application fields, the medical AI industry is facing huge development opportunities and various challenges. In order to facilitate the development of the medical AI industry, the innovation platform provides innovative solutions. However, with the increasingly complex demands from the development of the medical AI industry, the innovation platforms lack corresponding management model to tackle the tasks. Therefore, the goal of this study is to create an optimal innovation platform management model for the future development of medical AI industry.

This paper is mainly based on the problems and opportunities faced by the medical AI industry and innovative solutions provided by innovation platform, analyzes the future demand of the development of the medical AI industry, and explores the role of innovation platform in facilitating the development of medical AI industry, and build an innovation platform management model. Through a review of relevant literature and theories, this paper aims to provide insights into the strategic approaches that can be adopted by organizations seeking to leverage AI technologies in the medical industry.

The concepts and related theories involved in this study are shown below:

1. Problems and Challenges in the Development of Medical AI Industry
2. Opportunities and Trends in the Development of Medical AI Industry
3. Innovative Solutions of the Medical AI industry Innovation Platform
4. Analysis Framework for the Medical AI Industry Innovation Platform
5. Research Methods for Studying Management Elements of Innovation Platform

Problems and Challenges in the Development of Medical AI Industry

With the continuous development of the new generation of information technology and the continuous integration of the medical field, AI has been applied in different scenarios such as disease assisted diagnosis, medical decision-making, and

medical prevention, changing the traditional diagnosis and treatment mode and bringing profound changes to the medical field (Si, Li & Su, 2021). However, in the development process, medical AI in China faces various problems and challenges on such as medical data, algorithm, talents, clinical application, legal responsibilities and industry supervision, which need attention and solutions (Tan, Han & Ding, 2020, Shen, Chen & Li, 2021, Čartolovni, Tomičić & Lazić Mosler, 2022). Experts Li, Feng & Wang (2018) further pointed out that the medical AI industry faced three major challenges: firstly, it was difficult to obtain high-quality data, and the acquisition process lacked regulatory systems, making it difficult to guarantee patient privacy; Secondly, the core technologies had not yet made breakthrough, and many medical AI technologies were only auxiliary tools and remained in the experimental and developing stage; Thirdly, it was difficult to implement medical AI applications, and an industrial closed-loop has not yet been formed. Due to various issues such as algorithm, data standardization, product trustworthiness and monetization, policy regulation, the construction of medical AI systems requires deep cooperation between AI experts and medical experts to continuously learn and integrate the theory and practice of the medical industry, in order to making new breakthroughs in interpretability, small sample learning and privacy computing (Zhu & Lv, 2022, Meng, Zhang & Chen, 2023).

Table 2.1 Problems and Challenges in Medical AI Industry

	Medica Data	**Algorithm**	**Talents**	**Clinical Applications**	**Commer cialization**	**Ethics and Law**
Tan, Han & Ding (2020)	√	√	√	√		√
Shen, Chen & Li. (2021)	√	√	√	√		√
Čartolovni, Tomičić & Lazić Mosler (2022)	√	√	√	√		√
Li, Feng & Wang (2018)	√	√		√	√	√
Zhu & Lv. (2022)	√	√		√	√	√
Meng, Zhang & Chen (2023)	√	√		√	√	√
Total	**6**	**6**	**3**	**6**	**3**	**6**

Medical Data Issues

Experts found that due to the scarcity of high-quality training data, the lack of uniform industry data standards, and the absence of clear criteria for assessing medical data usage as well as effective supervision, a substantial amount of medical data fails to be optimally utilized, which constitutes a significant bottleneck in the development of healthcare AI (Shi & Liu, 2021; He & Hu, 2023). Experts Shen et al. (2023) further pointed out that there is currently a lack of medical technology innovation infrastructure such as terminology, knowledge base, and various standard datasets in China, and there are also difficulties in sharing medical data. The main obstacles are privacy security, data ownership, and benefit allocation (Ma, Yu & Cui, 2018).

Moreover, the existing standard data set is built for consensus and standards of single disease and single mode. But the mode of medical AI has expanded from image to signal, text, and even from single mode and multi-mode, in order to handling various disease types (Zhang, Chen, Mao & Deng, 2021).

Algorithmic Problems

Although medical AI holds immense potential for boosting medical output and facilitating faster, more objective, and accurate diagnoses by enhancing the skills of non-specialists, concerns have been raised regarding ensuring algorithmic reliability, eliminating algorithmic bias, and the possibility that the utilization of AI could lead to the deskilling of the specialist clinical workforce (Hallowell, Badger, McKay, Kerasidou & Nellåker, 2023).

AI as a technical tool cannot completely replace medical experts. The diagnosis model of medical AI is still a data-driven ‘black box’, the diagnosis results are inexplicable, and the construction of algorithms is essentially not integrated into medical knowledge (Liu & Wang, 2020). The opacity of AIs internal decision-making process where the rationale behind model decisions is inaccessible for human examination, frequently fosters practitioners' reluctance to fully trust model outputs without comprehending their underlying logic (Neves et al., 2024). This inherent opacity in AI decision-making, fostering automation bias and potential errors, significantly impedes broader trust and adoption of AI technologies (El Kafhali et al., 2023). Furthermore, fairness in AI/ML models cannot be achieved through a one-size-fits-all approach; rather, it requires context-specific strategies that consider the

relevance of patient demographics and the unique nature of healthcare decision-making (Agarwal.et al., 2023). For example, people of Europe, America, and China belong to different patient groups, and algorithms trained with one set of data may have problems diagnosing and treating patients in another group. Therefore, if we want to achieve the same accuracy, it is necessary to retrain the algorithms for specific patient population (Qian, 2023).

Talents Challenge

Whether there are high-quality interdisciplinary talents plays a decisive role in the development of AI algorithms, because medical AI theoretically involves two university disciplines, AI and medicine, and is a typical interdisciplinary field. However, few talents are proficient in these two aspects in China (Gao, Huang, Cao, Chen & Zheng, 2021).The AI education in Chinese universities focuses more on vertical applications, lacks interdisciplinary cooperation and multi technology integration innovation, and there is a gap with world-class universities (Zhao & Zhuang, 2023). In the era of AI, a well-balanced combination of AI implementers, AI complementors, and AI tools is crucial for driving innovation. AI-savvy managers also become increasingly sought after to bridge the gap between recognizing AI's potential and actual implementation (Zeljko & Johann, 2023). The partnership between humans and AI tools forms the core of AI-powered innovation, with AI tools automating specific tasks while requiring human oversight for data provision, tool setup, and interpretation (Verganti, Vendraminelli & Iansiti, 2020). According to reports, China's AI talent gap exceeds 5 million people, and the cultivation of medical talents takes at least 8 years, resulting in a scarcity of interdisciplinary talents with dual technical backgrounds in medicine and AI (Li & Zhang, 2020). Due to the scarcity and low quality of interdisciplinary talents in the AI field of China, this indirectly leads to a lack of research and development capabilities for key core technologies of AI in China, which limits the improvement of innovation ability and core competitiveness in the AI field (Wang, Chen & Zhao, 2020).

Clinical Application Issues

Medical AI products must pass multiple barrier such as research and development, test verification, evaluation and approval before clinical application, which requires high costs of time and technical, and cannot effectively meet clinical needs (Zheng et al., 2019). Moreover, from the existing medical AI products that have

obtained product registration certificates, AI can only solve one or several specific problems, making it difficult to form a service loop and may not necessarily reduce the workload of doctors. On the contrary, it may be counterproductive (iResearch. 2021). There are also studies showing that more and more medical activities are shifting from humans to machines centered around AI. However, how to ensure that these machines can be as safe and reliable as humans is a problem that hospitals, clinics, and innovative enterprises have to face (Liu, Xu & Tao, 2018). Due to data quality, algorithmic discrimination, and incomplete approval systems, the diagnostic effect is excessively exaggerated or biased, making it difficult to generate reliable research evidence or products for medical AI, which will bring complex technical uncertainty and unknown security risks to medical activities (Ji, Zhu, Xiao, Xu & Guo, 2022).

Commercialization Issues

The literature analysis reveals that most China AI companies only entered the medical field after 2015, and there were few projects commercialized from the research and development achievements. The products are mostly approved for marketing as Class II medical devices, and the overall commercialization level of the industry is relatively low (Wang, Chen & Zhao, 2020). It was not until January 2020 that China approved the first Class III registration certificate for medical AI products (Jiang, Xiong & Zhang, 2020). The research shows that medical AI companies that have obtained CNDA certification bid farewell to the free trial phase of their products and officially entered commercialization around 2018. However, for commercialization, relying solely on AI to solve medical problems is not enough, and the business model and monetization model are still not very clear. How to commercialize technology has become the most critical issue (Du, 2018). Many medical AI applications were facing the challenge of "who is the payer", and the application products of intelligent healthcare have not yet been integrated with the medical insurance system and hospital management (Li, Feng & Wang, 2018). As the "burning money" label of AI becomes increasingly apparent, medical AI enterprises relying on capital "transfusion" are under increasing pressure. Advanced technologies simply cannot establish a business model, and the commercialization core as capital required is to implement application scenarios (Luo, 2021).

Ethical and Legal Challenges

With the increasing number of medical AI clinical trials and the types of diseases involved, ethical and legal issues have become a focus of attention. For example, there are problems of the control of medical data usage permissions, the ownership of medical data, and the patient's right to informed consent (Zhang, Jin, Le & Xu, 2021). Due to the social and public nature of medical AI, health data is prone to leakage during transmission, and a large amount of health data can be easily captured during products testing (Wang & Guo, 2021). However, there are still no systematic and specialized laws and regulations in terms of information security and patient privacy protection, and there are also difficulties in judicial practice (Shen et al., 2023). In addition, the use of medical AI systems for medical treatment will lead to certain changes in the traditional doctor-patient relationship, and the legal relationship will add one more party in the main body, which also increases various uncontrollable problems. However, the existing legal system for risk liability and supervision of medical AI is still far from perfect (Zhao, 2021). Research has shown that in commercial applications, the monopoly of service resources by institutions with data and technology could lead to unfair distribution of medical resources, making public rights vulnerable to infringement risks (Ji et al., 2022).

Based on the above analysis, it can be concluded that the development of medical AI industry is facing a series of problems and challenges on medical data, algorithmic, talents, clinical application, commercialization, ethics & laws as listed below:

Table 2.2 Problems and Challenges in Medical AI Industry (Specific Elements)

	Shi & Liu (2021)	He &Hu (2023)	Shen et al. (2023)	MMa, Yu & Cui(2018)	Zhang, Chen, Mao & Deng (2021)	Hallowell, Badger, McKay (2023)	Liu & Wang (2020)	Neves et al. (2024)	EL Kafhali et al. (2023)	Agarwal.et al. (2023)	Qian (2023)	Ji, Zhu, Xiao, Xu & Guo (2022)	Zheng et al. (2019)	iResearch. (2022)	Li, Feng & Wang (2018)	Liu, Xu & Tao (2018)	Total
Medical Data																	
Lack of high quality data	√	√	√		√							√					5
Lack of data standards and sharing mechanism	√	√	√	√	√												5
Algorithm																	
Algorithmic bias						√			√	√	√						4
Lack of Interpretability						√	√	√			√						4
Clinical Application																	
Product launch approval costs time and money												√	√	√			3
Technology uncertainty and security risks												√	√	√	√		4

Table 2.2 (Continued)

	Gao, Huang, Cao, Chen & Zheng (2021)	Zhao & Zhuang (2023)	Zeljko & Johann (2023)	Verganti, Vendraminelli & Iansiti (2020)	Li & Zhang (2020)	Wang, Chen & Zhao (2020)	Jiang, Xiong & Zhang (2020)	Du (2018)	Luo (2021)	Shen et al. (2023)	Zhu & Lv (2022)	Ji et al. (2022)	Zhang, Jin, Le & Xu (2021)	Wang & Guo (2021)	Zhao (2021)	Total
Talents																
Scarcity of interdisciplinary talents	√	√	√	√	√	√										6
Commercialization																
Unclear of business model and monetization model							√	√	√							3
Ethics and Laws																
Information security and patient privacy protection										√	√	√	√	√	√	6
Legal system for risk liability and supervision											√	√	√	√	√	5

Opportunities and Trends in the Development of Medical AI Industry

The researcher conduct further literature review on the development trends and expert insights of the medical AI industry, and find that it mainly focuses on four aspects: infrastructure, technological innovation, application scenarios, and policies and regulations.

Infrastructure Aspect

AI has three core components: computing power, algorithm, and data (Zhu & Lv, 2022). High performance computing center provides support for cutting-edge algorithm model research, promotes the maturity of industry application scenarios, and forms an industrial ecosystem; Large scale knowledge base and algorithms promote the upgrading of big data to big knowledge. And data has the development characteristics of diversified scenarios, diverse samples, and specialized content (Li & Zhang, 2020; Lu, 2020). Researchers defined the new infrastructure construction for medical AI: providing necessary new technological support and infrastructure construction for AI applications in the medical field, covering medical big data, AI algorithms, cloud computing, etc. They proposed the following development goals: Firstly, to establish robust mechanisms for data governance, integration, and sharing; Secondly, to construct high-performance computing platforms, efficient storage systems, and cloud computing services; Thirdly, to develop medical big data models and advanced deep learning algorithms; Lastly, to leverage blockchain and other cutting-edge technologies to create a reliable, secure, and traceable multi-center collaborative platform for medical and health services. (Liu et al., 2023).

Medical Data

Experts Li et al. (2019) compared and analyzed the strategic planning and development status of medical AI at home and abroad, pointing out China's shortcomings in overall planning, development path, infrastructure, regulatory system, and so on. They advocated that China should prioritize the construction of data infrastructure such as platforms, standards and norms. Given that countries such as Europe and the United States have established relatively complete medical data infrastructure, experts Yuan et al. (2022) suggested that China should optimize infrastructure, focus on key areas for scientific and technological research, and strengthen the construction of data standard systems required for medical AI applications. Experts Pei & Yu (2023) predicted that the trend is to unify medical

terminology and disease codes, standardize the record of clinical diagnosis and treatment data, and improve the quality of medical data

At the same time, an open sharing mechanism should be established for data, dividing it into different levels of protection based on different levels of privacy, and setting different open permissions. The higher the level, the more approval processes are required for data access (Ma, Yu & Cui, 2018). Data governance is no longer the responsibility of a single organization. Rather, multiple networked entities play a role. Partnerships with healthcare organizations operating under one set of restrictions and large tech firms operating under a more relaxed regulatory regime facilitates medical AI innovation and monetization (Jenifer, 2019). The Japanese "Medical Big Data Law" has also provided inspiration to China. Experts suggested that China shall develop a systematic law for health and medical big data with Chinese characteristics, establishing a third-party medical information processing certification mechanism to promote the sharing of medical big data, establishing an internal review system, and a medical big data application evaluation and guarantee system (Liao, Tian & Liu, 2021).

Algorithm

In medical scenarios, AI algorithms can learn from patient health data, select feature data, match designed medical plans, and output decisions. Due to the black box effect and information opacity of AI algorithms, international organizations have issued documents regarding the "interpretability," "accountability," and "transparency" of AI algorithms as important goals (Yao, 2022), and a governance model should be built for AI in healthcare delivery, focusing on principles of fairness, accountability, and transparency (FAT), and trustworthiness (Reddy, Allan, Coghlan & Cooper, 2020).

Interpretability requires that AI must explain the decision-making process from input to output to humans. Based on a review of the relevant applications of AI technology in the medical field, experts pointed out that in the future, the interpretability of AI could be improved by upgrading the legal accountability mechanism for medical accidents, cultivating medical ethics, protecting medical data privacy, and strengthening medical supervision and governance (Zhang & Pi, 2023). The future research direction of interpretability in AI decision-making should shift from visual perception to inferential cognition, collaborate and complement human decision-making, and provide explanations for different stakeholders in decision-

making (Kong, Tang & Wang, 2021). Need for fairness in medical care is not limited to algorithm design but also to other aspects including input data, model parameters, and visualization and embedding of model results in the medical care workflow. Meanwhile, the type of fairness needed, such as unawareness, demographic parity, equalized odds, predictive rate parity, etc., is highly dependent upon the use case and the risk associated with the outcome (Ahmad, et al., 2021).

Table 2.3 Opportunities and Trends for Infrastructure Aspect

	Zhu &Lv (2022)	Li & Zhang (2020)	Lu (2020)	Liu et al. (2023)	Li et al. (2019)	Yuan et al. (2022)	Pei & Yu (2023)	Ma, Yu & Cui (2018)	Liao, Tian & Liu (2021)	Jenifer (2019)	Yao (2022)	Reddy, Allan, Coghlan & Cooper (2020)	Zhang & Pi (2023)	Kong, Tang & Wang (2021)	Ahmad, et al. (2021)	Total
Medical Data																
Construct medical data standards	√	√	√	√	√	√	√									7
Protect medical data privacy	√	√	√	√				√	√	√						7
Algorithm																
Make the decision-making process fairness, accountability, and transparency				√							√	√	√	√	√	6

Technology Innovation Aspect

Breakthroughs in core technologies are key to the development of medical AI and possessing high-level talents plays a decisive role in technology innovation.

Key Core Technologies

The fundamental research of AI includes two aspects: one is basic science, and the other is humanities and social science. However, China lags behind developed countries such as European countries and USA in both aspects and should continue to invest in this area (Zhang, 2019). Experts found that there were bottleneck problems in key core technologies such as advanced integrated circuit technology, precision optical device control, and core algorithms through data analysis of global AI chip patents. These technological fields are mainly blocked by the United States, the Netherlands, Japan, South Korea, France, etc. China needs to strengthen its independent research and innovation capabilities in these fields, in order to achieve breakthroughs in key core technologies of the AI chip industry (Chen, Jiang, Xiong & Zhang, 2023). For example, deep learning algorithms have high requirements for large-scale parallel computing capabilities, while traditional computing architectures cannot meet such needs. Therefore, AI chips with new architectures should be rapidly developed Although patents in the field of AI chips are mainly held by Japan and the United States, lately Chinese institutions such as Inspur Group and Chinese Academy of Sciences have significantly increased their patent layout in this field, and China's technology advantages in the field of CPLD and are FPGA obvious (Wang, Lv, Zhang, Zhao & Qian, 2021). At the same time, the strong demand of computing power for AI and machine learning is accelerating the race to develop cheaper and faster AI chips, tech giants from different countries have been successively joining the race. Both Chinese tech giants, such as Baidu and Huawei, and the front runners of AI chip startups, such as Cambricon and Iluvatar CoreX, have released their own AI chips, The market share among GPUs, FPGAs, and ASICs is likely to change, as well (Pang, 2022).

The World Intellectual Property Organization (WIPO) subdivides AI technologies into five fields: machine learning, fuzzy logic, logical programming, physical engineering, and probabilistic reasoning. In terms of AI application, the most patented fields are computer vision, speech processing, and natural language processing (Dai & Gu, 2020). The direction of medical AI technology innovation is to

build new models based on deep learning, innovate the diagnosis and treatment models of human-machine cooperation, and precision medicine relying on cognitive intelligence and medical big data (Zhou & Fei, 2021). The research found that AI development is undergoing a paradigm shift, driving large AI models to transform biomedical and health domains. The new paradigm learns versatile foundational models through large-scale multi-modal datasets, breaking down boundaries between different intelligent tasks and data modalities. The large AI models will enhance rather than replace medical professionals' capabilities and foster deep human-AI collaboration (Qiu et al., 2023). More specifically, generative AI and large language models can assist in medical image analysis and diagnosis, develop new drugs and treatments, and create personalized treatment plans based on patient data. These developments in AI technology are expected to be applied to the healthcare industry and create new value (Park, Kim, Yoon, Kamyod & Kim, 2023; Clusmann, Kolbinger, Muti, 2023). Medical AI is developing towards multi-model data, integrated systems, software and hardware integration, cognitive intelligence, knowledge driven. China needs to continue to deepen innovative research at the theoretical, technological, and application levels (Shen et al., 2023).

Innovative Talents

Having high-level talents plays a decisive role in technology innovation. There are two main paths for the gathering of medical AI talents internationally: one path is, in the form of research institutes and startups, to attract talents from home and abroad to conduct fundamental research and entrepreneurship, forming a pool of talents and projects; another path is, in the form of funding and training, to cultivate medical AI interdisciplinary talents for the application need (Wang, Chen & Zhao, 2020). Strong interdisciplinary education programs should be further fostered, to improve the quality of researchers and practitioners and to help the dissemination of AI methods and principles in the biomedical informatics community. China should change the existing medical professional training mode, establish a interdisciplinary AI education and diversified talent cultivation system (Fan & Tan, 2019; Zhao & Zhuang, 2023). It is also crucial for China to build high-quality AI teaching teams, jointly build shared laboratory platforms, and establish scientific evaluation system for cultivating versatile and applied medical talents (Wang & Hu, 2021). Experts have further proposed the "subject responsibility system" talent training model for medical AI,

exploring the integration of industry and education. It means that schools and employers jointly develop talent training plans based on the needs of both parties, adopting personalized training to achieve maximum talent utility (Mao, 2020).

Table 2.4 Opportunities and Trends for Technology Innovation Aspect

	Zhang (2019)	Chen, Jiang, Xiong & Zhan. (2023)	Wang, Lv, Zhang, Zhao & Qian (2021)	Pang (2022)	Dai & Gu (2020)	Zhou & Fei (2021)	JQiu et al. (2023)	Park, Kim, Yoon, Kamyod & Kim (2023)	Clusmann, Kolbinger, Muti. (2023)	Shen et al. (2023)	Wang, Chen & Zhao (2020)	Fan & Tan (2019)	Zhao & Zhuang (2023)	Wang & Hu (2021)	Mao (2020)	Total
Key Core Technologies																
Develop AI chips	√	√	√	√												4
Develop Large AI models					√	√	√	√	√	√						6
Innovative Talents																
Establish inter-disciplinary talent development system											√	√	√	√	√	5

Application Scenario Aspect

The key to the development of the medical AI industry lies in the implementation of AI technology in medical scenarios. The rapid implementation of application scenarios can promote the technology upgrading and iteration, build a data-driven business loop, and become a laboratory for AI technology experimentation, maturity, and application. Scenario development needs to meet

the demands of segmented applications, accurate position, and form scale effect (Yuan, Zhao & Tian, 2020; Fan & An, 2022).

Clinical Application

With the accelerated penetration of AI technology into the medical field, the application scenarios have become increasingly diverse. The research has found that there were several main application scenarios for medical AI: intelligent diagnosis and treatment, personalized medicine, drug research and development, medical imaging, and intelligent health (Holzinger, Keiblinger, Holub, Zatloukal & Müller, 2023; Ye, Ma & Wang, 2023). Medical imaging is the most widely segmented scene in medical AI, and AI can be used to intelligently analyze and learn image data from various medical imaging systems, including ultrasound, X-ray, CT, and MRI, to achieve lesion localization, image segmentation, and 3D reconstruction (Jin & Feng, 2021). However, from the perspective of depth and breadth, there is still great room for the development in medical AI application scenarios. In terms of depth, medical AI needs to penetrate into the clinical diagnosis and treatment process, constructing models with multiple diseases, multiple parts, and multiple modalities, from embedding the core link to the entire chain, to form an integrated AI diagnosis and treatment plan. In terms of breadth, medical AI needs to enable grassroots hospitals to have a higher level of diagnosis, achieve early diagnosis and treatment of diseases, and assist in refining the system of tiered medical services (Zhu & Lv, 2022). Experts Huo et al. (2023) also pointed out that medical staff participation enhanced acceptance of medical AI through the cognitive path and the effective path.

From a demand-side perspective, medical AI should improve medical efficiency, accuracy, and standardization, more in line with clinical medical needs, develop personalized treatment plans for patients, and reduce work load for doctors (Li, Zhang, Li & Chen, 2021). The research shows that personalized and IoT-based healthcare services can be realized through control and monitoring applications that are typically developed using AI based algorithms, that play a significant role to highlight the efficiency of traditional healthcare systems. The goal of future healthcare is set up to achieve a fully autonomous healthcare service, that takes into account the interdependent effect of different health conditions of a patient (Taimoor and Rehman, 2022). Other studies show that harnessing the potential of AI-based methodologies such as big data, IoT, blockchain for the development of

tailored medical diagnosis and treatment will be increasingly important in the future since the design, development, and usage of these personalized solutions will primarily depend on AI and other computational models (Dilsizian & Siegel, 2014; Pandurangan et al., 2024).

Commercialization

The market size of medical AI has been expanding year by year with broad prospects, but it is still in the early stage of development. The country is attempting to use various policy tools to provide comprehensive support (Ye et al., 2023). China should carry out medical AI pilot projects and promote application demonstration (Wang, Chen & Chao, 2020). For the commercialization of medical AI, it is extremely important to do well in four aspects: technical validation, business model experiments, business market validation, and replication models (Luo, 2021). With technological advances, big data analytics and AI has opened new avenues of competition, where data are utilized strategically and treated as a continuously changing asset able to unleash new revenue opportunities for monetization (Firouzi, Farahani, Barzegari & Daneshmand, 2022).

Table 2.5 Opportunities and Trends for Application Scenario Aspect

	Yuan, Zhao & Tian (2020)	Fan & An (2022)	Holzinger, Keiblinger, Holub, Zatloukal & Müller (2023)	Ye, Ma & Wang (2023)	Jin & Feng (2021)	Zhu & Lv (2022)	Huo et al. (2023)	Li, Zhang, Li & Chen (2021)	Taimoor & Rehman (2022)	Dilsizian & Siegel (2014)	Pandurangan et al. (2024)	Wang, Chen & Chao (2020)	Jin & Feng (2021)	Luo (2021)	Firouzi, Farahani, Barzegari & Daneshmand (2022)	Total
Clinical Application																
Meet demands of segmented scenes	√	√	√	√	√	√	√									7
Form integrated AI solutions for personalized diagnosis and treatment	√	√						√	√	√	√					6
Commercialization																
Build business loop and pilot projects	√	√		√								√	√	√	√	7

Policies and Regulations Aspect

Industrial Policies

Governments of various countries have launched AI related strategic plans and industrial policies to promote the application and development of AI technology in the medical field. Since 2015, the Chinese government has successively promulgated a series of policies and documents, including Development Plan for the New Generation of Artificial Intelligence, Deepening Activities of 'Internet plus Medical Health' for the Benefit of the People, Guidelines for the Construction of the National New Generation of Artificial Intelligence Standard System, Development Plan for the Medical Equipment Industry (2021-2025), and Guiding Principles for the

Classification and Definition of Artificial Intelligence Medical Software Products, etc, It is proposed to accelerate the innovative application of AI in segmented fields such as medical imaging, smart hospital, new drug research and development, and medical robots, and promote the innovative development of the medical AI industry (Li et al., 2019). Furthermore, experts Jia, Qi & Sun (2023) proposed a governance system framework for the AI industry under policy embedding, with corresponding management inspirations: strengthening industrial policies subject collaboration, optimization of policy resource allocation, adjustment of policy tool structure, constructing and expanding policy application areas, etc

The US government has issued a series of policies and documents, including National Strategic Plan for Artificial Intelligence Research and Development, Report on Artificial Intelligence, Automation, and the Economy, Summary of the 2018 White House Summit on Industrial Artificial Intelligence in the United States of America, and Artificial Intelligence Initiative of the United States of America, to consolidate its leading position in the forefront of AI technology and fundamental momentum for long-term development. In response to the rapid development and regulatory issues of medical digital products (including AI), the United States has also promulgated medical AI industry guidance such as 21st Century Treatment Act, Digital Health Innovation Plan (DHIAP), and Mobile Medical Application Guide to restructure the digital health product supervision system (Xie, 2021).

The National Health Service (NHS) of the United Kingdom has released a medium - and long-term health service system development plan, increasing the breadth and depth of AI application in the medical field and making digital medicine mainstream. The plan is to accelerate the application of AI from five main aspects: AI empowerment, assistance to health and nursing professionals, AI application in clinical diagnosis and treatment, AI health management, and improvement of safety and efficiency, so as to realize the innovation of service mode and the overall transformation of the system (Niu, Xie, Cheng, Lv & Liu, 2020).

Korean government has designated bio-health as a key new industry since 2017, boosting its R&D budget, indicating sustained health project support. Meanwhile, the Ministry of Science and ICT advanced 'My Data business', enabling individuals to manage and share health data. Korean government actively promotes deregulation on novel technologies like revising the Data 3 Act, and in its Korean New

Deal initiative from July 2020, it aims to institutionalize smart medical care through projects like 'Smart Medical Infrastructure', featuring digital hospitals with real-time patient monitoring and inter-institutional collaboration (Han & Lee, 2021).

Although countries around the world are attempting to further the development of disease diagnosis, treatment, drug development, chronic disease management, and medical robots through the deep integration of AI technology and healthcare, the researcher find there are differences in planning and layout of medical AI among various countries. European and American countries focus on basic research and technology development, and emphasize the deep integration of AI technology and basic biology/medicine, However, Japan and China pay more attention to specific medical application scenarios (Yuan et al., 2022).

Ethics and Law

The research points out that the lengthy and challenging approval process in China for medical AI products, mismatched with their rapid development cycles, amplifies financial and temporal costs for enterprises, impedes product iteration, and coupled with a lack of legal support that exposes healthcare institutions to potential liability, dampens their enthusiasm for adopting such technologies (Wang, Chen & Zhao, 2020). In the AI era, China needs to devise fundamental principles (people-centric, individual equality, algorithm transparency) and refine specific rules for medical AI liability due to the current confusion surrounding the civil legal status of subjects and objects in medical AI, which cannot be fully addressed by traditional liability frameworks (Wu, 2021). Therefore, Chinese government and all sectors of society urgently need to build a comprehensive and multi-level ethical governance system from the aspects of policy formulation, legal framework, scientific research and technology research and development by strengthening top-level design, improving policies and regulations, attaching importance to public feedback, and strengthening interdisciplinary cooperation. If regulatory rationalization and market environment improvement are supported, the digital healthcare industry is expected to play an important role in realizing a healthy life by enabling the provision of routine healthcare services (Lu, Wang, Zheng, Li & Huang, 2021; Ye, Shen, Jiang & Yuan, 2024).

It is crucial to look at some challenges and risks of AI through the lens of ethics. AI ethics involves ensuring machines' behavior towards humans and other

machines, incorporating societal values, moral considerations, and the ability to explain reasoning transparently from various perspectives; thus, AI development necessitates embedding ethical principles and rule of law at its core design and cognition stage, not merely during human interaction, given their autonomous evolution (Chauhan & Keprate, 2022). The entire process from design to application of medical AI should be centered around human interests and well-being. Through the deep integration of ethical values, "technology-ethics" integration should be carried out, clarifying the responsibilities and obligations of all stakeholders. This is the basis for effective prevention and control of ethical risks in intelligent medical AI. Under the premise of ensuring innovative development, a balance between reasonable control of ethical risks and technology innovation should be achieved within a prudent regulatory framework (Zhao & Guo, 2023). For example, the EU currently offers a holistic legal and ethical foundation for regulating AI technologies, comprising implemented hard regulatory measures, ongoing legislative processes for additional stringent regulations, and soft ethical guidelines (Braun & Harasimiuk, 2023).

But it's worth noting that governments are increasingly interested in technical standards development, accentuating the political dimension of standardization, because AI, reflecting the social and political biases of its creators, amplifies power structures in society as it becomes embedded, driving a competitive "AI race" with implications for the global socio-political order (Gamito, 2023). Despite governments' regulatory efforts, the evolution of ethical AI governance is a complex interplay between private and public sectors, where private actors actively shape state policies and standards to manage competition and risks. Non-state actors, especially standard-setting bodies, significantly shape AI governance, challenging state authority and international norms (Auld, Casovan, Clarke & Faveri, 2022).

Table 2.6 Opportunities and Trends for Policies and Regulations Aspect

	Li et al. (2019)	Jia, Qi & Sun (2023)	Xie (2021)	Niu, Xie, Cheng, Lv & Liu (2020)	Han & Lee (2021)	Yuan et al. (2022)	Wang, Chen & Zhao (2020)	Wu (2021)	Lu, Wang, Zheng, Li & Huang	Ye, Shen, Jiang & Yuan (2024)	Chauhan & Keprate (2022)	Zhao & Guo (2023)	Braun & Harasimiuk (2023)	Gamito (2023)	Auld, Casovan, Clarke & Faveri(2022)	Total
Industrial Policies																
Provide Industrial policies support	√	√	√	√	√	√										6
Ethics and Law																
Issue regulation on new technologies							√	√	√	√			√			5
Establish ethical governance										√	√	√	√	√	√	6

Based on the above literature research, the future development opportunities and trends are reflected in four aspects:

1 Infrastructure

1.1 medical data

1.2 algorithm

2 technology innovation

2.1 key core technologies

2.2 innovative talents

3 application scenario

3.1 clinical application

3.2 commercialization

4 policies and laws

4.1 industrial policies

4.2 ethics and law.

Innovative Solutions of the Medical AI industry Innovation Platform

Role Positioning of Innovation Platform

In order to promote the AI technology innovation and industry development, China has recognized 15 state-leveled open innovation platforms for AI since 2017, fully leveraging the leading and exemplary role of industry leading enterprises and research institutions, and taking "openness and sharing" as an important concept for the construction of Innovation Platforms. Subsequently, various provinces of China also invited well-known experts from domestic universities, institutions, and leading enterprises to participate in the innovation development of AI, building open and collaborative innovation platforms, reducing the threshold and cost of AI application for small and medium-sized enterprises, and accelerating the multi-scenario applications and industrial intensive agglomeration development (Wang, Chen, Shang & Wang, 2023).

The open innovation platform for AI has become the infrastructure for promoting the integration of AI and industry applications (Li, 2020). It can effectively integrate technology resources, industrial chain resources, and financial resources, empowering the high-quality development of the industry (Lu, 2020).

International AI companies are opening up their AI platforms due to the innovation platform's capability to furnish the underlying architecture and interfaces for AI basic algorithms. These underlying architecture and algorithms have the potential to spearhead industrial progress and foster synchronized development between terminal scenarios and cloud services. With this objective, the companies aim to expedite their technological proficiency in various industry organizations, capture customers, applications, and data resources, and gradually establish novel industrial patterns and technical standards (Wang & Chen, 2018).

Innovation platforms, as institutions or organizations that integrate various innovative elements such as technology, talent, and policies, support and serve innovation activities (Zhao, 2016), characterized by the integration, aggregation, and open sharing of technological resources (Chen, 2013). In recent years, comprehensive innovation platforms have emerged in China, led by the government or other organizations, integrating scientific research, technology development, innovation incubation, and public services. It has dual attributes of innovation and trading, focusing not only on national strategic demands and technology innovation tasks,

but also on service trading and demand matching. The two aspects complement each other to achieve value creation (Mao, Cao & Fang, 2021; Wang, Cai & Sheng, 2018).

Development Trends and suggestions of Innovation Platform

However, the study found that the research and development of AI in China was increasingly concentrated in universities and research institutes. Due to the lack of leading effect from large and top-level enterprises, the efficiency of industrialization was low. In addition, the government's strong intervention in the market hinders the market-oriented allocation of factors. Therefore, it is suggested that China's government should step back from market activities and hand over the power of resource allocation to the market; In terms of public interest, governments, enterprises, and other stakeholders should establish negotiation and innovation mechanisms, and jointly design application scenarios in various regions to maximize the interests of all parties (Zhang, 2019; Chen, 2022). Expert Chen (2021) further suggested that China should plan its application layout in the multi-field cross-cutting and integration in advance to promote integrated innovation between AI and the real economy, that is, a complex of strategic innovation, collaborative innovation, comprehensive innovation, and open innovation.

For the innovation platform itself, it is necessary to further establish a sound and efficient organizational structure system, establish a technology development system and management model that is suitable for modern enterprise development, and achieve sustainable development in innovation competition (Cai & Tian, 2022). The development strategy of innovation platforms should emphasize openness, focus on improving diversity and platform system performance, in order to create ecological value (HE & GUO, 2022). Experts Wang, Chen, Shang & Wang (2023) also pointed out that innovation platforms face problems such as incomplete multi-party collaborative mechanisms, fewer global leading enterprises, and the lack of an ecosystem with global influence. After studying the development of new generation AI innovation in Guangdong province, China. They suggested that innovation platforms needed to gradually improve top-level design, upgrade data processing technology, accelerate the construction of innovation consortia and build open innovation ecosystem.

It can be seen that in the process of promoting AI technology innovation and industry development, innovation platforms mainly play an extremely important role in resource integration, open sharing, resource allocation, demand matching, and so on. They are important innovation carriers for continuously outputting core research and development capabilities and service capabilities. At the same time, the organizational structure and management model of the innovation platform are not fixed, but dynamically adjusted to adapt to changes in innovation demands. The research on the roles and development trends of innovation platforms is shown in Table 2.7.

Table 2.7 Roles and Development Trends of Innovation Platform

	Wang et al. (2023)	Li Xiuquan (2020)	Lu Juan (2020)	Wang & Chen (2018)	Zhao (2016)	Chen (2013)	Mao, Cao & Fang (2021)	Wang, Cai & Sheng(2018)	Zhang (2019)	Chen (2022)	Chen (2021)	Cai &Tian (2022)	HE &GUO (2022)	Wang, Chen, Shang & Wang (2023)	Total
Role positioning															
Integrate various innovative elements to support innovation activities	√	√	√	√	√	√	√	√							8
Accelerate multi-scenario applications	√	√	√	√			√	√							6
Development Trends															
Establish organizational structure system and collaborative mechanisms									√	√	√	√		√	5
top-level design and build open innovation ecosystem												√	√	√	3

Theoretical Basis for Innovation Platform Value Creation

The main driving force for innovation platform value creation is platform capability, which refers to the aggregation of platform resources and capabilities, as well as the embodiment of organizational structure, continuously adapting to the external environment to capture requirements and achieve value creation (Zhang, Jin, Le & Xu, 2021). Platform value creation is a complex dynamic process that goes through three stages, from perceiving needs to acquiring opportunities, and then restructuring and allocating resources, ultimately achieving value. Therefore, by managing and improving various micro conditions, the innovation and service capabilities of the platform can be enhanced (Sheng, Liu & Shi, 2022).

This study analyzes the theoretical basis of value creation for innovation platforms and find that there are three major theoretical supports behind them: platform empowerment theory, industry symbiosis theory, and synergy theory. These theories enhance innovation capabilities and platform performance through value co-creation, mutual benefit, and efficient collaboration respectively.

Platform Empowerment Theory

The empowerment theory extends from the earliest internal power arrangement within organizations to the external, i.e. cross organizational empowerment. It mainly focuses on how new organizations with flattened structures and flexible boundaries can connect various external stakeholders, engage in open leadership, and form value co-creation through external empowerment (Chen, 2021).

Platform empowerment is based on two aspects: firstly, the platform is based on its pivotal position and unique resources in the ecosystem, possessing the most shared knowledge and information, and exerting more influence on other stakeholders; Secondly, the platform empowers other members in the community of interests, enabling them to acquire high-level capabilities (Zhu, Sun & Zhou. 2019). This is because the platform is the creator and executor of the system, coordinate relationships such as "control and autonomy" through governance mechanisms to ensure collaboration and division of labor in the value co creation process. Other enterprises on the platform are embedded as participants in the platform and provide complementary resources (Ramaswamy & Ozcan, 2016). Platforms influence the results of value co-creation through mechanisms such as value proposition alignment, benign interactive dialogue, and resource optimization and integration,

and comprehensively and systematically reveal the diverse participation of value co-creation. Thus, platform builders are required to attach importance to the role of other stakeholders and environmental factors, and create a diverse symbiotic value network (Chen, 2021).

The experts Wang, Fan & Sun (2021) deduced and constructed a three-tiered analytical framework for platform empowerment, drawing insights from the traditional viewpoints of structural, leadership, and psychological empowerment. At the macro level, the framework emphasizes the ecological foundation and institutional policies that shape the empowerment environment of the platform. Moving to the meso level, it focuses on the leadership behavior and distinguishing characteristics that define the empowerment subject within the platform. Finally, at the micro level, the framework zeroes in on the individual organizational personality and ability traits that comprise the empowerment object.

In addition to structural empowerment, scholars Cao & Kong (2020) have conducted research on scenario driven innovation empowerment and and technological empowerment. Scenario driven innovation empowerment refers to the application of new technologies to specific scenarios, thus creating greater value. It is also based on future trends and development needs, driving the deep integration of innovative elements such as strategy, technology, organization and situational elements, breaking existing technological bottlenecks, developing new technologies, new products, new channels, new business models, and even new markets (Yin, Su, Chen & Chen, 2022). From the practical perspective of specific innovation scenarios, by building industrial digital dynamic capabilities, it is possible to significantly enhance the precise perception and efficient control of business opportunities, as well as the coordination of multiple internal and external entities within the organization, improving the organizational efficiency, the industrial reconstruction and supply chain transformation (Yin, Lu & Chen, 2023). Scenario driven means to take scenario demands as the core, driving technology and organization to work together along the path of "data integration scene restoration resource recombination governance iteration", in order to achieve complexity restoration and distributed empowerment of complex demands (Fang, Li & Wei, 2024).

In the wave of digitization, innovative technology and its generated data have become a brand new production factor (Cai & Chen, 2019). Platform enterprises, as

hubs and core interactive relationships in the value network, effectively promote value co-creation between consumers and entrepreneurs through resource empowerment and data empowerment (Zhou, Chen & Deng, 2019). Breakthrough technologies enable the upgrading and transformation of enterprises, industries, and even the economy and society through the core mechanism of "empowerment" (Guan, Xue & Zhao, 2019). The new platform is not only a technology importer, integrator, and innovator, but also a technology enabler. In emerging business models such as platform economy and sharing economy, technologies empower new industrial organizations on the platform, forming multiple economic forms, driving the transformation of market structure, and thus achieving the creation of new social services (Fan, 2021). For example, a cancer management platform has been designed to help patients to manage their cancer in all aspects, in close collaboration of clinical experts, IT specialists and patients, with decision support and analysis tools (Kondylakis et al., 2017).

In summary, the core of platform empowerment is to empower the community of interests in the value network based on its pivotal position and unique resources, thereby achieving value co-creation. According to the size of the value space and the relationship between the elements of value realization, platform empowerment includes structural empowerment, relationship empowerment, technology empowerment, and so on. This provides an important basis for platform builders to leverage the role of other stakeholders and environmental factors to create a diverse symbiotic value network. The research on platform empowerment theory is shown in Table 2.8.

Table 2.8 Platform empowerment theory

	Chen (2021)	Zhu, Sun & Zhou (2019)	Ramaswamy & Ozcan (2016)	Chen (2021)	Wang, Fan & Sun (2021)	Cao & Kong (2020)	Yin, Su, Chen & Chen (2022)	Yin, Lu & Chen (2023)	Fang, Li & Wei (2024)	Cai & Chen (2019)	Zhou, Chen & Deng (2019)	Guan, Xue & Zhao (2019)	Fan (2021)	Kondylakis et al. (2017)	Total
Structural Empowerment (flexible boundaries, interactive relationship, governance mechanisms, resource allocation)	√	√	√	√	√										5
Scenario driven Empowerment						√	√	√	√						4
Technology Empowerment										√	√	√	√	√	5

Industrial Symbiosis Theory

Industry Symbiosis refers to the cooperation and exchange between regional industries to jointly improve the survival and profitability of enterprises. At the same time, through this cooperation, resource conservation and environmental protection are achieved. Later on, industrial symbiosis is further expanded to infrastructure sharing, service information sharing, and technological innovation knowledge sharing (Xu & Wang, 2015). The collection of various relationships involved in industrial cooperation forms the industrial ecosystem, among which the enterprises involved in production and exchange through industrial cooperation are called symbiotic units; The cooperation mode between enterprises is called symbiotic mode; The external conditions for the existence of corporate cooperative relationships are called symbiotic environments (Chen & Xia, 2007). The basic conditions for an industrial symbiotic environment include policy support, legal protection, economic

foundation, technological support, and talent resources. The sum of contact methods and mechanisms between symbiotic enterprises, and efficient material carriers or media such as logistics, human flow, capital flow, and information flow, forms symbiotic interfaces, which are the foundation for the formation and development of industrial symbiotic relationships (Zhang, Feng, Xiao, Ma & Fu, 2013).

Industrial symbiosis improves the operation model and technical process of traditional enterprises through the exchange and sharing between and within industries, so as to achieve sustainable industrial development. Mutualistic symbiosis and symbiotic evolution are the essence of symbiotic systems. The most important feature of industrial symbiosis is the formation of relatively stable equity, formal or informal contracts and other symbiotic endogenous media, which eliminates the randomness of symbiotic objects and reduces the loss and distortion of information and energy in the transmission process (Chen & Xia, 2007).

The formation of the network of industrial symbiosis is driven by two factors. One is the economic, environmental, and social benefits that can be achieved by industrial symbiosis (Han, Yang, Li & Shi, 2019). Another crucial driving factor is the network embedding of enterprises, including economic embedding based on spatial level, institutional embedding based on organizational and institutional level, social embedding based on cognitive level (Zhang & Yu, 2008). The evolution of industrial symbiosis networks is influenced by various factors both inside and outside the system, including technological demand, resource availability, infrastructure improvement, and the participation enthusiasm of various stakeholders (Taddeo, Simboli, Morgante & Erkman, 2017). External factors include market changes, environmental protection, industry policies, rules and regulations, etc. (Costa, Massard & Agarwal, 2010). When these factors play a positive role, such as promoting industrial symbiotic development through innovation incentives (Taddeo, Simboli, Ioppolo & Morgante, 2017). By strengthening institutional capacity building to ensure the economic benefits of industrial symbiosis (Wang, Deutz & Chen, 2017). It will promote the positive evolution of the industrial symbiotic network,

Based on the above literature research, it is found that industrial symbiosis achieves mutual benefit and coexistence through the exchange and sharing of material, information, energy, and other resources between and within industries. The collection of all relationships involved in industrial cooperation forms an industrial

ecosystem. The formation of industrial symbiotic networks is influenced by the total benefits generated by enterprise symbiosis, as well as the embedding of enterprise networks. Industrial symbiotic networks can evolve and develop positively driven by internal and external factors.

Synergy Theory

The theory of synergy was first proposed by German scientist Hermann Haken. He defined it as "Synergetics" and referred it to the collaboration between various parts of a system, resulting in the formation of a new structure and characteristics that are not present at the micro individual level. Synergetics studies how open systems spontaneously exhibit ordered structures in time, space, and function through their internal synergy in the exchange of material or energy with the outside world (Haken, 1997). The expert Bao (2019) believes that Haken's synergy theory emphasizes that cooperation plays a dominant role in the formation of system order in most cases. Without effective cooperation between parts, all organisms cannot survive, and the image of self-organization is explained from a systematic perspective.

Expert Wang (2019) summarized the characteristics of synergy theory into four aspects, that were, positioning in the field of technological innovation and resource complementarity effects, positioning in the synergistic effects brought about by the differences in human knowledge and ideas, the research from organizational integrity to cross functional synergy, and the study of the collaborative functions between organizations. While experts Porto-Gomez, Zabala-Iturriagagoitia & Leydesdorff (2019) thought Innovative economies generated new options from geographical, technological, and organizational synergies. The extent to which these new contexts support innovation depended considerably on the quality and intensity of the relationships kept within and among systems. Moreover, a study carried out by expert Rasiah (2019) found that the evolution of technology (including digitalization, big data analytic and smart machines) had raised the potential for attracting the participation of all socioeconomic agents in innovation networks, and proposed an open systems model with institutional underpinnings to quicken knowledge flows and expand the networks to a wider range of socioeconomic agents, and to facilitate their inclusive participation in shaping the processes of achieving sustainable development through environmental greening and egalitarian balancing of society. And another research found that synergy with platform owners and other

complementors was critical for participant of small and medium enterprises to contribute innovation rapidly for improving their own performance, because the platform owners and other complementors would furnish different sets of information and knowledge, which were complementary in nature. With regards to platform owners, it was essential to strategically design the ecosystem by encouraging interactions between actors (Wu, Song & Liu, 2022).

Based on the above literature research, the core of synergy theory is efficient interaction and collaboration. Through the collaboration of various sub-units in the ecological network, the overall value is greater than the sum of individual values. The synergy theory has gradually expanded from the internal of organizations to the strategic level between organizations, and then from cross-organizational collaborative effects to multi subject, multi-level, and multifunctional collaborative innovation networks.

The research on industrial symbiosis theory and synergy theory is shown in Table 2.9.

Table 2.9 Industrial Symbiosis Theory and Synergy Theory

	Xu & Wang (2015)	Chen & Xia (2007)	Zhang, Feng, Xiao, Ma & Fu, (2013)	Han, Yang, Li & Shi (2019)	Zhang & Yu (2008)	Taddeo, Simboli, Morgante & Erkman (2017)	ICosta, Massard & Agarwal (2010)	Taddeo, Simboli, Ioppolo & Morgante	Wang, Deutz & Chen (2017)	Haken (1997)	Bao (2019)	Wang (2019)	Porto-Gomez, Zabala-Iturriagagoitia & Leydesdorff (2019)	Rasiah (2019)	(Wu, Song & Liu (2022)	Total
Industrial Symbiosis Theory (cooperation, exchange, sharing)	√	√	√	√	√	√	√	√	√							9
Synergy Theory (effective cooperation, differences and complementarity effects)										√	√	√	√	√	√	6

Analysis Framework for the Medical AI Industry Innovation Platform

From the literature review above, it is found that the medical AI industry faces a series of problems and challenges in the development process, including data, algorithm, talents, clinical applications, legal responsibilities, and industry regulation. The future development opportunities and trends of the medical AI industry focuses on infrastructure, technological innovation, application scenarios, and policy regulations. To solve the problems encountered in the process of industrial development, the medical AI industry innovation platform provides innovative solutions through resource aggregation, innovation ecology, open sharing, resource allocation, etc., meanwhile, there are management needs in the top-level design, organizational structure, and institutional mechanism of innovation subjects.

This study adopts the TOE theoretical framework combined with the theory basis of innovation platform to sort out and analyze the key influencing factors of the development of the medical AI industry and innovation platform performance, then use these influencing factors to construct an indicator system for the management of innovation platform.

TOE Analysis Framework

The TOE (Technology Organization Environment) theory was proposed by Tornatzky in his book "The Process of Technological Innovation". It categorizes the factors that affect an organization's innovation and group adoption of new technologies into three aspects: technology, organization, and environment. In different contexts, the influencing factors covered by these three aspects vary. Policy makers can optimize resource allocation from three aspects: technology, organization, and environment based on the current status of resource allocation elements on innovation platforms, in order to achieve high innovation performance (Zhang, Zhang, Ma & Huang, 2022).

Therefore, this study utilizes the extensiveness of the TOE framework and the generality of factor classification criteria to readjust and select the influencing factors within each aspect. From a holistic perspective, it constructs an analysis framework for three aspects of technology (T), organization (O), and environment (E), as well as eight influencing factors, to explore the indicators and management path that affect the innovation platform of the medical AI industry.

The technology aspect includes three influencing factors: infrastructure, generic technologies, and innovative talents. High quality innovative talents can reduce the investment of organizations in learning and time costs. A sound infrastructure includes computing power, algorithms, and data. Generic technology breakthroughs can help organizations reduce the difficulty of applying new technologies and improve the performance of technology applications. Therefore, infrastructure, generic technologies, and innovative talents can help accelerate the output and the transformation of research and development in the innovation ecosystem, effectively improving innovation efficiency.

The organization aspect includes three influencing factors: organization structure, and institutional mechanism. Different innovation entities have different resources and capabilities, participate in innovation activities with different roles, and through reasonable organizational structure and institutional mechanism design, work together to actively promote the innovation performance of emerging industries.

The environment aspects includes two influencing factors: industrial policies, laws and regulations. The government provides support through industrial policies such as funding, taxation, and subsidies, and the industrialization process of innovation platforms is also constrained by imperfect policies and regulations.

The specific TOE analysis framework is shown in Figure 2.1.

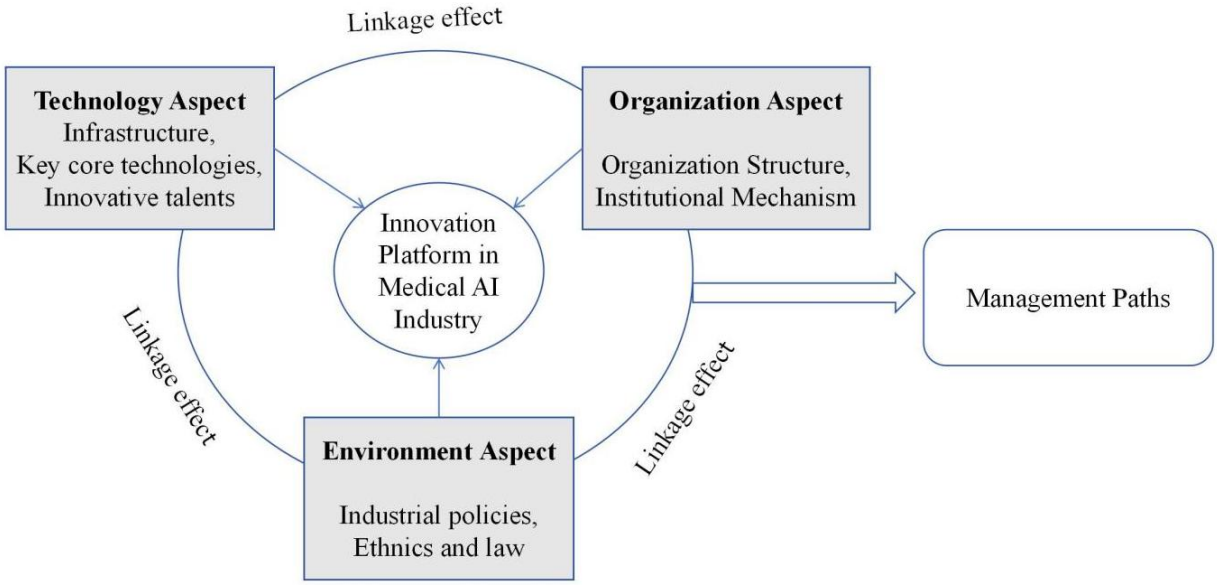


Figure 2.1 TOE Analysis Framework

Analysis Framework of Theoretical Basis of Innovation Platform

The above TOE framework analyzes the influencing factors of the relationship among technology, organization, and environment at three aspects. However, there are still many factors that affect industrial development and innovation platform performance. For example, the medical AI industry requires deep integration of medical technology and AI technology to meet clinical needs, while innovation platforms need to form innovation alliances with various stakeholders and jointly design application scenarios to promote industrialization and realize commercial value. Therefore, in order to achieve a more rigorous and comprehensive analysis, the researcher further explores innovation platforms and its value creation process, supplements the key influencing factors of the foundational theories.

The researcher combines the three theories of platform empowerment theory, industry symbiosis theory, and collaboration theory as the underlying theories to investigate the future demand of the medical AI and the management mode of innovation platform.

Research Methods for Studying Management Elements of Innovation Platform for the Medical AI Industry

In-depth Interview Method

The in-depth interviewing method is often used to explore a multitude of substantive and theoretical topics (Davis Hicks, 2004). More and more sociologists use this method because it allows them to explore in detail peoples subjective experiences, meaning-making, and unspoken assumptions about the social world in general (Orrange, 2003). The interviews should be semi-structured and consist mostly of open-ended questions, which allows the interviewees to express deep feelings and give rich detail about specific experiences (Wu, 2019; Yang & Sun, 2005). The most important question in an in-depth interview is the "probe," a question asked to follow up and explore issues brought up by the interviewee (Lucas, 2014).

Expert Confirmation Process

An expert confirmation process is used to evaluate management elements and model. Its core is to consult relevant experts' opinions anonymously, make statistics, analyze expert opinions, and finally obtain more extensive expert collective results after the survey. It is necessary to use the experience of numerous experts to quantify the indicators of the research object, and then provide an analytical basis for specific problem research.

Snowball Sampling Method

Snowball sampling Method is an approach that does not rely on random selection, where participants already involved in a research project assist in identifying and including subsequent participants. It is commonly employed in qualitative studies, especially when the target group is elusive or not readily accessible. This method is particularly effective for investigating subjects that are sensitive in nature or when the individuals of interest are challenging to find (Wright & Stein, 2005). The technique begins with a core group of initial participants, known as seeds. These individuals then introduce the researcher to additional potential participants from the intended demographic. This cycle of referrals continues, with each new participant potentially leading the researcher to more individuals, until the target sample size is achieved.

Median Value and Inter-quartile Range (IQR)

The median value and inter-quartile range (IQR) can be find by following the steps: First, arrange data from smallest to largest. Then find the median, which is the middle value or average of two middle values for even-numbered data sets. Next, calculate the medians of the data's upper and lower halves, excluding the overall median if the total count is odd. Finally, subtract the lower median from the upper to get the IQR. This range measures data spread, excluding potential outliers

Chapter 3

Research Methodology

In Chapter 3, the purpose of this study and the research question and objectives are briefly presented, followed by the details about the research design, sampling strategy, data collection and data analysis. Also included in the chapter are information about the participants, the instruments used to collect and analyze data.

Purpose of the Study

The purpose of this study is to develop an innovation platform management model to break through the existing problems in the current medical AI industry and promote the future development of the industry. The following primary research question provided a guide for this study:

What is the appropriate management model for the innovation platforms to facilitate the future development of medical AI industry?

This study aim is not to make decisions for the innovation platform management, but rather, to provide available options presented by an informed group for consideration by decision makers. This study may assist decision makers in understanding the optimal management model that facilitate the future development of medical AI industry. Innovation platform may benefit from this study by learning the potential contextual factors affecting the strategic decision-making.

Research Design and Methodology

The researcher sought to identify specific themes supporting the management model that innovation platforms can build successful approaches to break through the existing problems in the medical AI industry and promote the future development of the industry. The researcher chooses qualitative methods to obtain the insights of the innovation platform and medical AI industry to develop an effective management model rather than conduct a quantitative study to collect current data to quantify opinions. Of the many methods that researcher uses to conduct qualitative studies, the in-depth interview method and expert confirmation process suit this study well, because these methods are to help explore and optimize the management model.

The research design follows the three steps depicted in Figure 3.1 and is described in detail as the following.

Step 1: to analyze the existing problems, opportunities and innovative solutions in the medical AI industry. This study selects literature journals, academic works, and documents for literature analysis. By this method, problems and challenges, opportunities and trend, innovative solutions during the development of the medical AI industry are identified. Relate elements are extracted from the concepts, models, evaluation and comments of the medical AI industry and innovation platform. Meanwhile, based on the analysis framework of TOE and innovation platform underlying theories: platform empowerment theory, industry symbiosis theory, and synergy theory, the elements are further induced in five aspects: infrastructure, technology innovation, application scenarios, policies and regulations, platform organization. Then, an in-depth interview is adopted in this step to explore the research topic and five experts are invited to participate in depth interviews. Finally, the elements for innovation platform management are studied and summarized.

Step 2: to evaluate the consistency of innovation platform management elements for the medical AI industry. In this step 17 experts from different stakeholders are invited to participate in the elements evaluation. The researcher modifies the management elements according to expert scoring and feedback.

Step 3: to create and confirm the innovation platform management model for the future development of the medical AI industry. In this step the innovation platform management model is created. Another experts panel is selected to confirm the model. Five experts from different stakeholders are invited to participate in the survey. Reliability and validity of the innovation platform management model are confirmed through expert scoring and feedback.

The three steps of research design are summarized as shown in Figure 3.1.

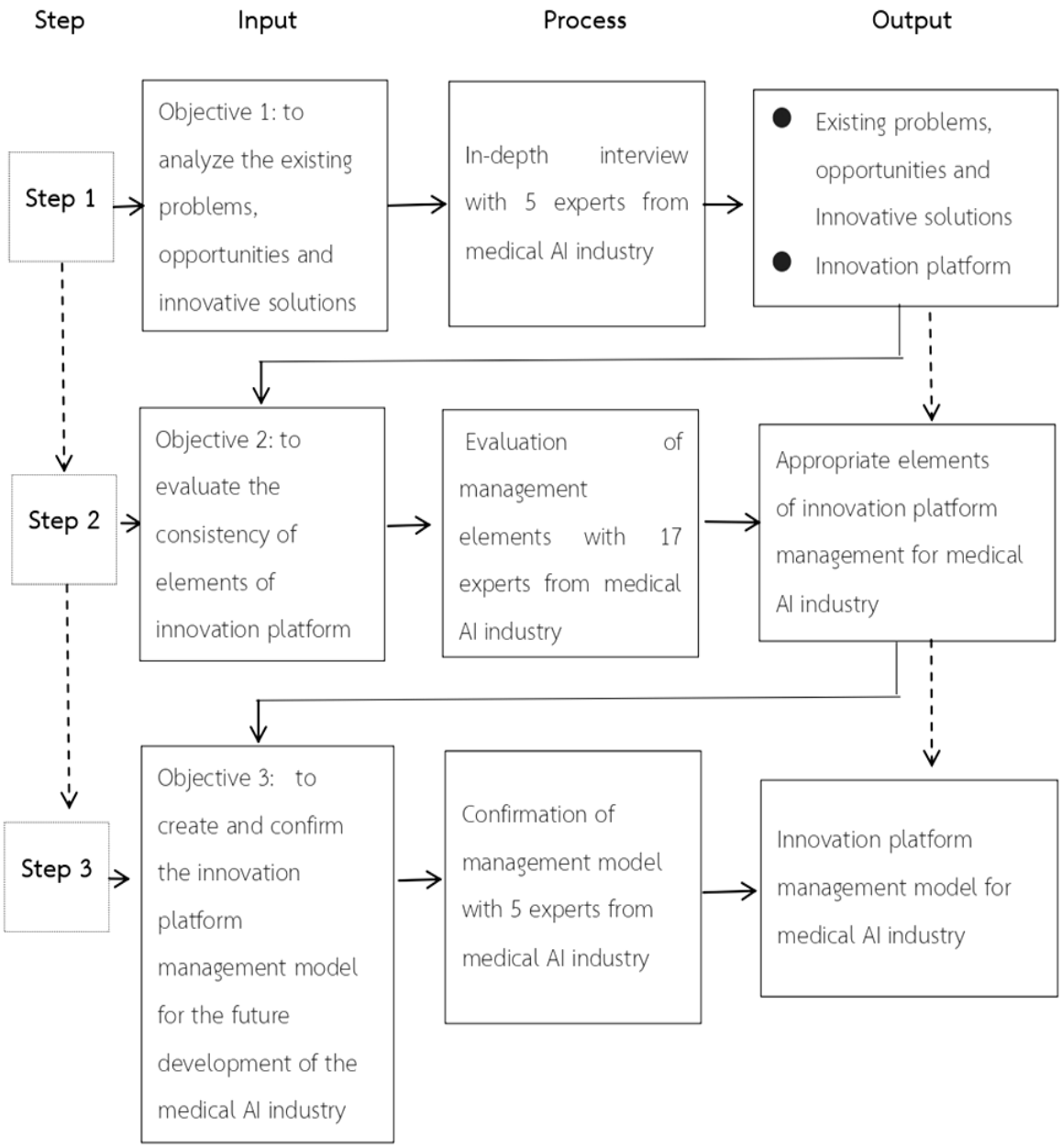


Figure 3.1 Research Process

Step 1 To analyze the existing problems, opportunities and innovative solutions in the medical AI industry

Literature Search and Analysis

The initial step involved in this study is to list the construct, element and criteria identified through literature search and analysis

Literature search. In this step the development of the medical AI industry and the practice of innovation platforms are reviewed. The researcher develops a search criteria to determine the appropriate keywords. "artificial intelligence technology", "medical artificial intelligence", "medical artificial intelligence policies and regulations" and "medical artificial intelligence industry development", "science and technology innovation platform" and "development trend of medical AI", as well as "platform empowerment" and "industry symbiosis", “synergy theory” are used as search keywords to conduct literature searches on CNKI, CQVIP, China Online Journals, SCIENCEDIRECT, IEEE, Web of Science, and Wiley Online Library. The literature published in the last six years (from January 1, 2018 to December 31, 2023) are searched , together with relevant documents such as industrial reports, academic works, and national policies and regulations are referred, they constitute the literature reference pool for this study.

Literature analysis. After literature screening and article by article analysis by the researcher, main issues, challenges and opportunities during the development of the medical AI industry are identified. Indicators related to the medical AI industry and innovation platform are extracted. Meanwhile, several rounds of discussions are held on the analysis of three theories: platform empowerment theory, industry symbiosis theory, and synergy theory. Based on the analysis framework of TOE and underlying theories, five aspects of the innovation platform management are roughly formed. They are infrastructure, technology innovation, application scenarios, policies and regulations, platform organization.

In-Depth Interview

An in-depth interview is adopted in this step to further explore the management aspects and elements for developing an innovation platform management model.

Population

Stakeholders in the medical AI industry, including universities and research institutes, medical AI enterprises, hospitals, and investors

Sample group

This study selects five experts from the population by snowball sampling method for in-depth interview based on the following criteria,

1) has a bachelor degree or above in education;

2) at least 5 years of work experience in medical AI or related field;

3) considering that diversity of knowledge and position can provide different perspectives, experts come from different stakeholders in the medical AI industry.

The expert panel for in-depth interview is shown as Table 3.1

Table 3.1 Experts Panel for In-Depth Interview

Stakeholders	Description of Organization	Work Position	Experts
University	to cultivate talents and do basic study of new technology	Professor/Research Fellow/Director	1
Research Institute	to develop key technology, transform scientific and technological achievements, and build industry-university-research platform and industrial ecology	Professor/Research Fellow/Director	1
Medical AI start-ups	to provide innovative medical AI products or services to the market	CEO/CTO/Founder	1
Medical AI listed Company	to provide market channels to innovative products and purchase innovative start-ups	Manager/CEO	1
Investor	to provide capital support for medical AI innovation projects	CEO/Investment Manager	1

Research Instruments

The tool used in this research is semi-structured interview.

The procedures for creating the tool are as follows,

(1) Clarify the research purpose. The research purpose of the interview is clarified to ensure that the contents of the outlines are consistent with the research objectives. This in-depth interview is to further explore the management dimensions and elements for developing the prototype of management model.

(2) Determine the category of the problem. On the basis of the initial step of research, determine the types of questions, such as the interviewee background, general questions and specific details about the research topic. Begin with general questions, and if necessary, probe questions are asked in order to find out hidden information. Ask open-ended questioning instead of closed questioning, such as: Can you give me an example? Can you elaborate on this idea? Can you further explain?

(3) Assumption of answers in advance. When preparing questions, make ensure that the questions can cover diverse viewpoints and experiences. Provide fixed question and answer options for each topic and question. This will help to ensure the consistency and comparability of data .

(4) Ask for expert opinions. Before using the interview outlines formally, ask for the opinions of three experts. Check the validity of each content, whether the expression is appropriate and clear, and whether the content is complete.

(5) Revision: Revise and improve the interview outlines according to experts' opinions.

Data Collection

1. Online interview: send semi-structured interview outlines through online software;

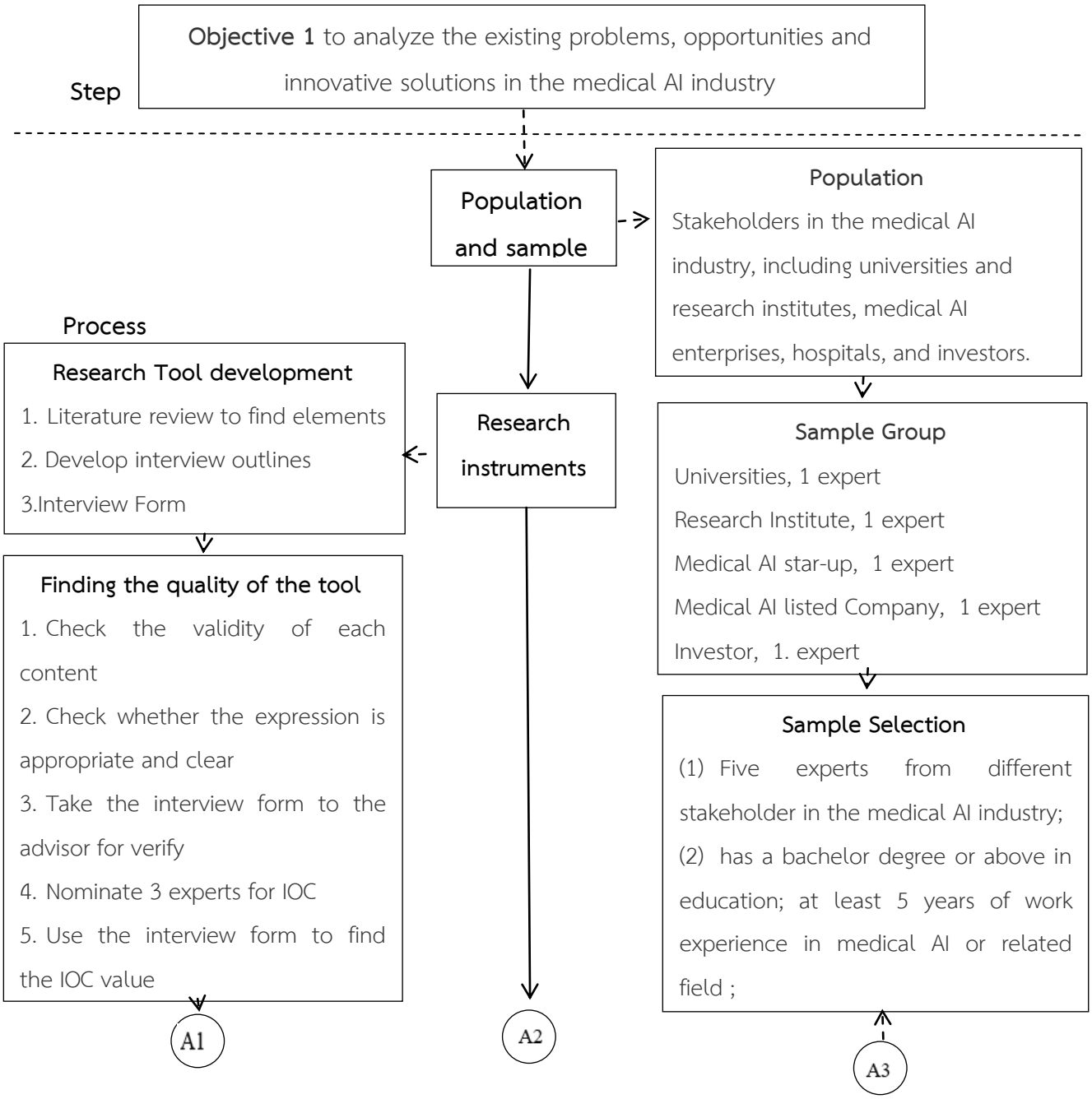
2. Telephone interview: take interview on telephone;

3. Transcripts and records: during the interview, write down all the information with the interviewee. After the interview, interview materials should be organized to summarize the key information of each interview. If necessary, feedback to the interviewee for confirmation.

Data Analysis

Carefully read all interview feedback, encode and roughly categorize the content, and search for models or themes in the participants' feedback. Then analyze and categorize the data under each theme to form a series of indicators.

The detailed research process of step1 is summarized as shown in Figure 3.2.



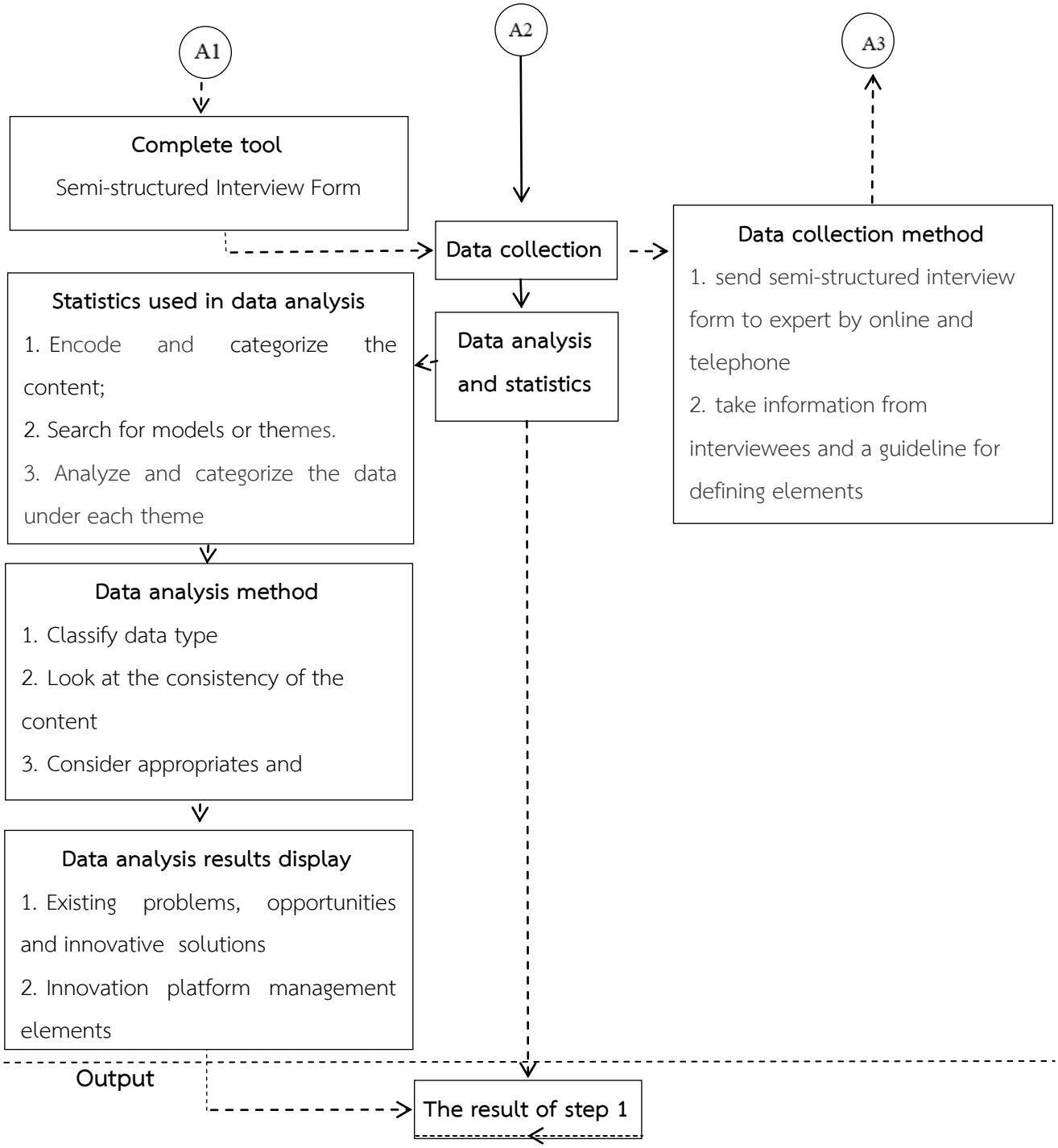


Figure 3.2 Details of the research process step 1

Step 2 to evaluate the consistency of innovation platform management elements for the medical AI industry

An expert panel is selected in this step to evaluate the consistency of elements of innovation platform management for the medical AI industry.

Population

Stakeholders in the medical AI industry, including universities and research institutes, medical AI enterprises, hospitals, and investors

Sample group

This study selects 17 experts from the population by snowball sampling method for elements evaluation based on the following criteria,

1. has a bachelor degree or above in education;
2. a minimum of 5 years experience in medical AI or related field;
3. considering that diversity of knowledge and position can provide different perspectives, experts come from different stakeholders in the medical AI industry.

Sampling

Sample Size. The selection population for this study consists of stakeholders in the medical AI industry. The panel size of expert confirmation process chosen from the population is 17 experts with medical AI work experience.

Selection of Participants

To avoid selection bias and ensure a multi-level perspective, the researcher identifies relevant stakeholders in the medical AI industry, including universities and research institutes, medical AI enterprises, government department, hospitals and investors. Such a heterogeneous expert panel ensures precise and robust results, compensating for individuals cognitive biases (Winkler & Moser, 2016). The experts are selected by snowball sampling method whereby a process is started with a small group of initial contacts. These participants then introduce the researcher to additional potential participants from the target population. This cycle of referrals continues, until the desire sample size is achieved.

For the detailed composition of the selected respondents, see Table3.2.

Table 3.2 Experts Panel for Elements Evaluation

Stakeholders	Description of Organization	Work Position	Experts
University	to cultivate talents and do basic study of new technology	Professor/Research Fellow/Director	1
Research Institute	to develop key technology, transform scientific and technological achievements, and build industry-university-research platform and industrial ecology	Professor/Research Fellow/Director	1
Medical AI start-ups	to provide innovative medical AI products or services to the market	CEO/CTO/Founder	6
Medical AI listed Company	to provide market channels to the innovative products and purchase innovative enterprise	Manager/CEO	3
Hospital	to provide application scenarios of medical AI technology based on the needs of patients, doctors and internal management, and formulate performance evaluation criteria on medical application	Discipline Director/ViceDean of the Hospital	2
Investor	to provide capital support for medical AI innovation projects	CEO/Investment Manager	3
Government Department	to provide policy guide for the development of medical AI industry	Government Officials	1

Research Instrument

This study uses survey scales and evaluation form as research instruments to obtain and analyze quantitative data on criteria developed based on management elements of innovation platform.

The evaluation form is developed on the aspects, themes and elements from literature analysis and in-depth interview. Before constructing the questionnaire, the literature analysis and in-depth interview are conducted to discover the problems and challenges, opportunities and trends, innovative solutions in the medical AI industry.

The five-point Likert scale is selected for the evaluation form of this study. The researcher sends the evaluation form to the participants for review and conceptualize the attitude of the panelist in terms of low to high consistency. Each item is assigned a value from 1 to 5, in which 1 means not consistency and 5 means extremely consistency. Comments are given to assess the consistency of the management elements of innovation platform.

Data Collection

The evaluation forms are dispatched to the experts via the Wechat software platform, allowing them a duration of one week to complete them thoroughly. The evaluation form comprises several key sections:

(1) Evaluation topic;

(2) Detailed instructions for filling out the evaluation form;

(3) Basic information about the experts, encompassing their age, educational background, work experience pertaining to medical AI, their profession, work organization, and position held. This information is crucial in understanding the experts' qualifications and perspectives, thereby enhancing the credibility and reliability of the evaluation.

(4) Experts assessment on the consistency of management elements. They are instructed to carefully consider the specifications outlined in each item and evaluate how well these are adhered to in practice.

(5) Evaluation form includes a section titled "Suggestions and Reasons," which encourages participants to voice their opinions and provide feedback. This open-ended section allows for a more comprehensive understanding of the experts'

perspectives and offers insights that can be used to further refine the management elements

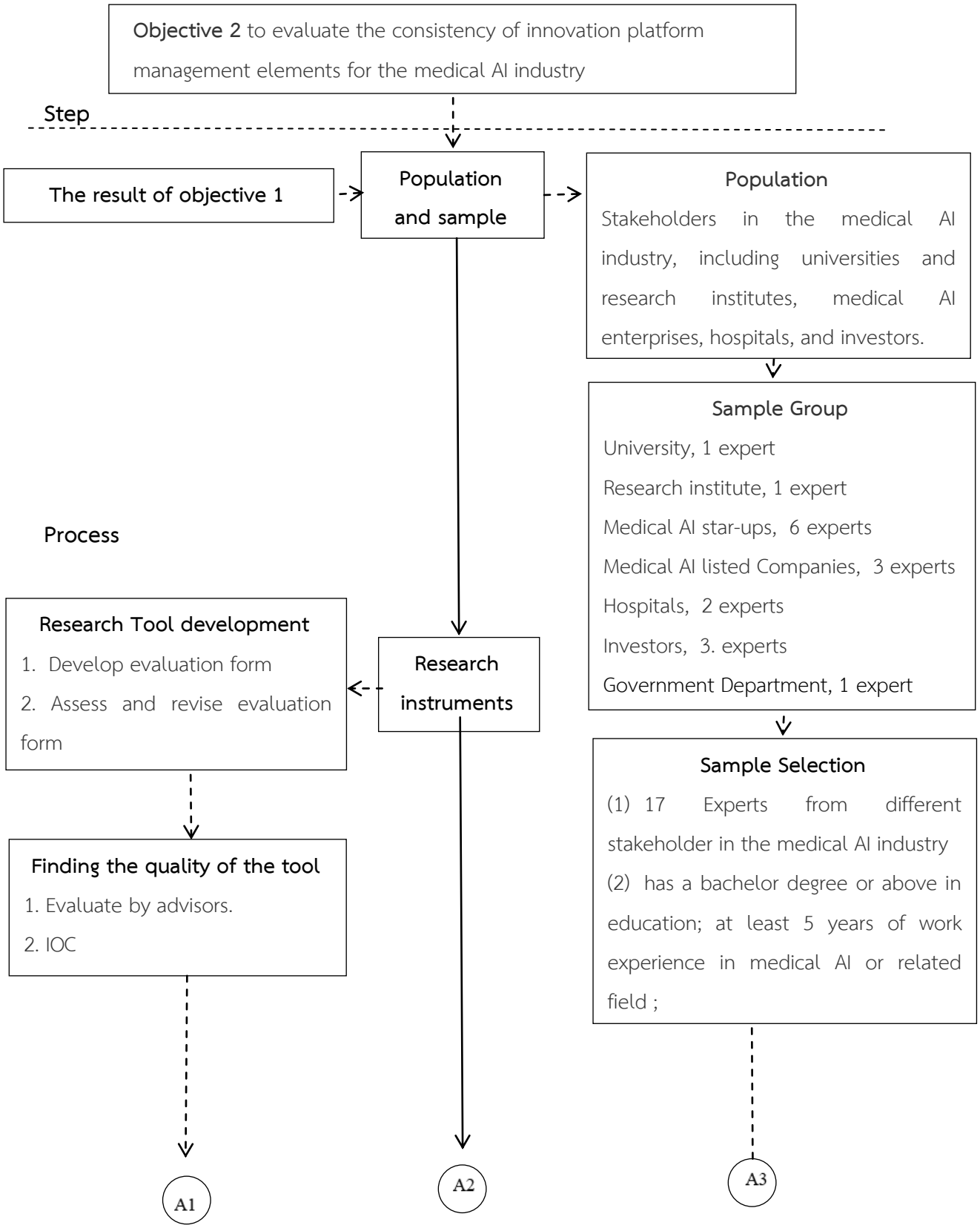
(6) In order to making the management elements more complete, open-ended questions are listed at the end of each episode. Experts can give additional comments or suggestions for the integrity of each aspect of the evaluation form.

Data analysis and statistics used in data analysis

Measurement criteria: For necessity, the median value and inter-quartile rang are measured. median value is an index reflecting the trend of expert opinions; Only can the median value >3.5 inter-quartile rang <1.5 be retained.

Statistical method: establish a database of expert consultation forms, and use statistic package program to conduct statistical analysis on the returned correspondence questionnaires.

The detailed research process of step2 is summarized as shown in Figure 3.3


Objective 2 to evaluate the consistency of innovation platform management elements for the medical AI industry
Step
The result of objective 1
Population and sample
Population
Stakeholders in the medical AI industry, including universities and research institutes, medical AI enterprises, hospitals, and investors.
Sample Group
University, 1 expert
Research institute, 1 expert
Medical AI star-ups, 6 experts
Medical AI listed Companies, 3 experts
Hospitals, 2 experts
Investors, 3. experts
Government Department, 1 expert
Sample Selection
(1) 17 Experts from different stakeholder in the medical AI industry
(2) has a bachelor degree or above in education; at least 5 years of work experience in medical AI or related field ;
Process
Research instruments
Research Tool development
1. Develop evaluation form
2. Assess and revise evaluation form
Finding the quality of the tool
1. Evaluate by advisors.
2. IOC
A1
A2
A3

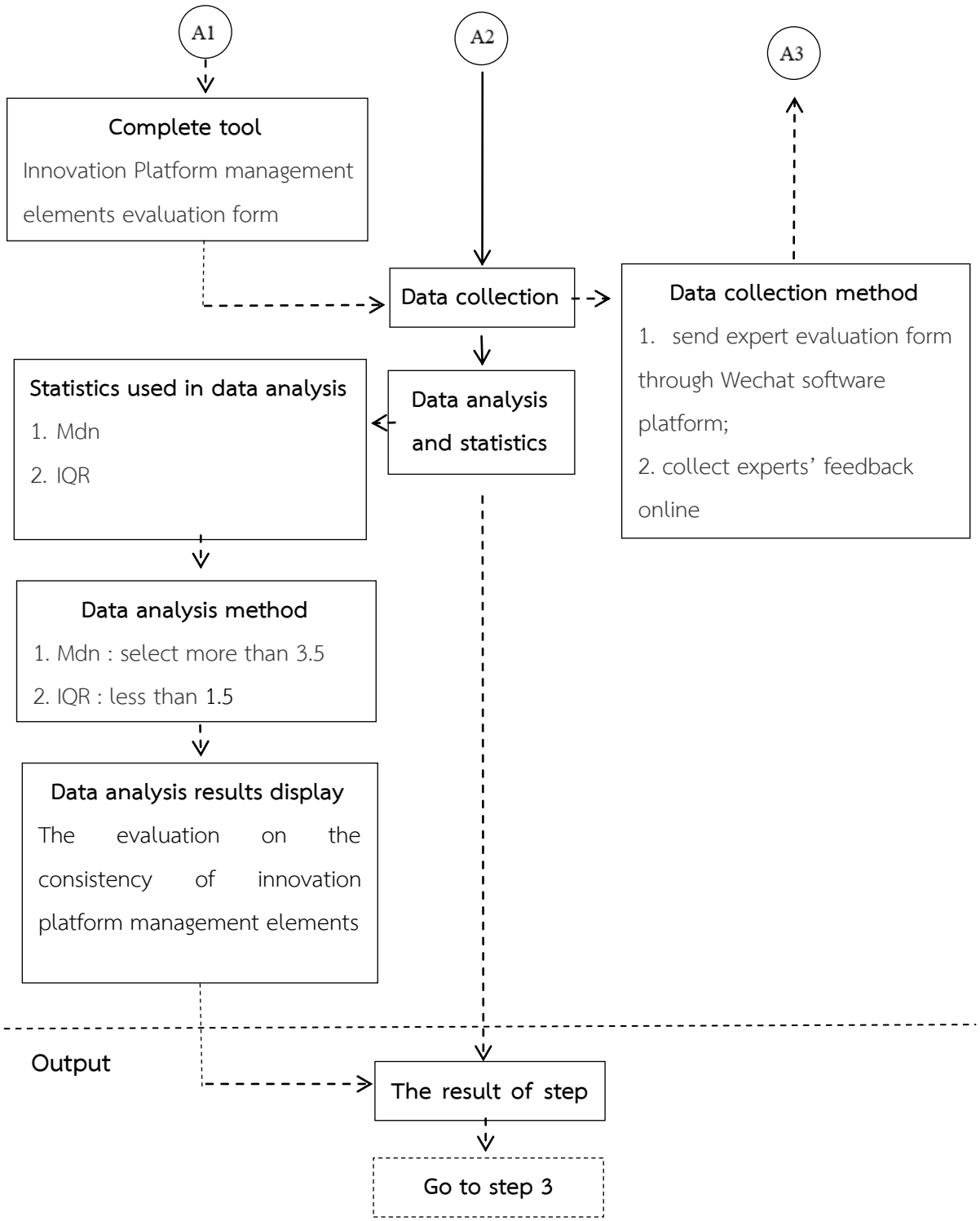


Figure 3.3 Details of the research process step 2

Step 3 to create and confirm the innovation platform management model for the future development of the medical AI industry

Population

Stakeholders in the medical AI industry, including university and research institute, medical AI enterprises, hospital, and investor.

Sample group

Five experts from different stakeholders will be selected to participate in expert survey of the innovation platform management model. The experts are selected snowball sampling method with the same criteria as that of step 2. But the experts of these two groups are different. Experts panel for model evaluation is shown as Table 3.3.

Table 3.3 Experts panel for model confirmation.

Stakeholders	Description of Organization	Work Position	Experts
University	to cultivate talents and do basic study of new technology	Professor/Research Fellow/Director	1
Research Institute	to solve key technology problems, transform scientific and technological achievements, and build industry-university-research platform and industrial ecology	Professor/Research Fellow/Director	1
Medical AI start-ups	to provide innovative medical AI products or services to the market	CEO/CTO/Founder	1
Medical AI listed Company	to provide market channels to the innovative products and purchase innovative enterprise	Manager/CEO	1
Hospital	to provide application scenarios of medical AI technology based on the needs of patients, doctors and internal management, and formulate performance evaluation criteria on medical application	Discipline Director/Vice Dean of the Hospital	1
Investor	to provide capital support for medical AI innovation projects	CEO/Investment Manager	1

Data Collection

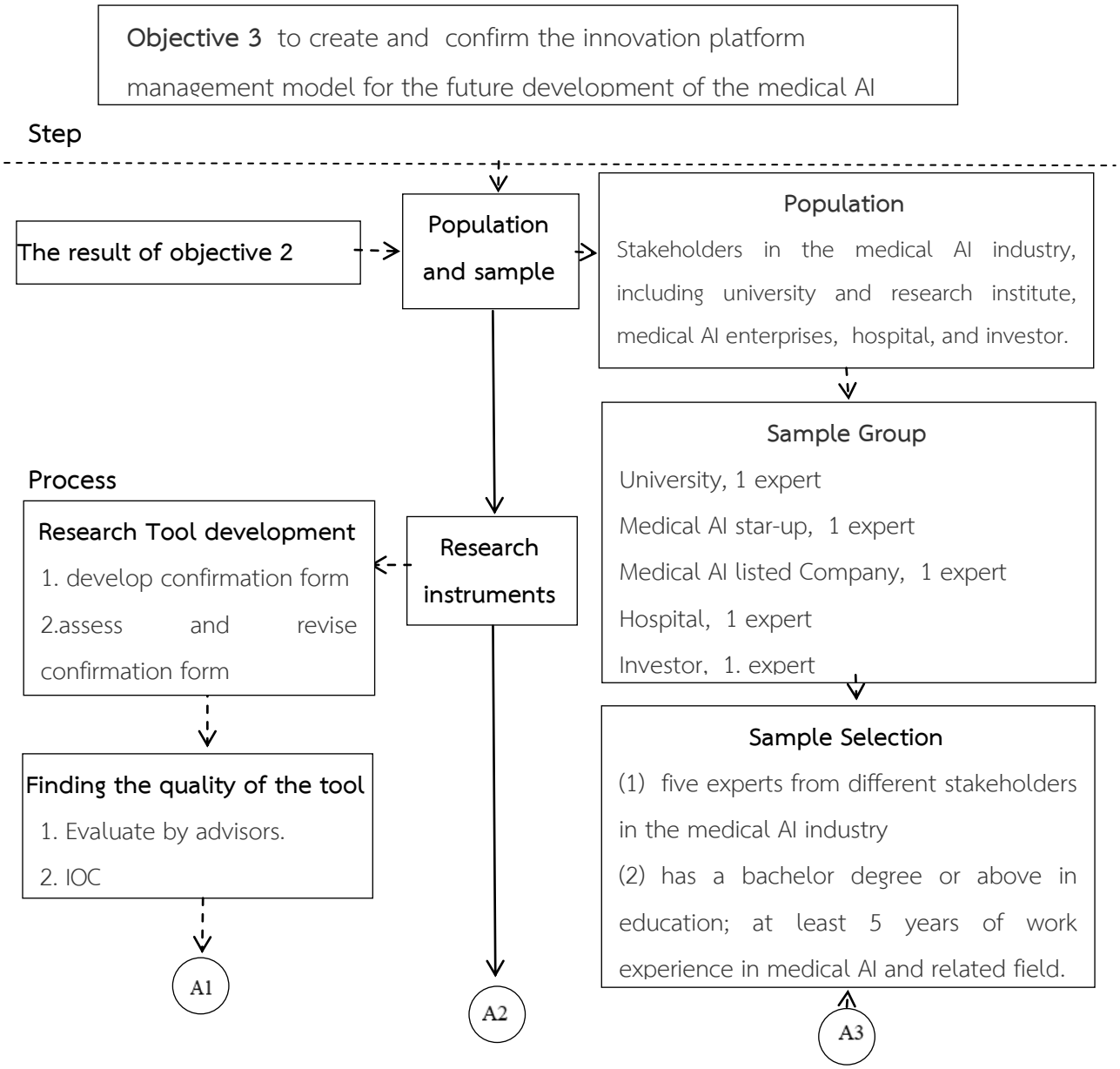
The variables of the updated management model will be designed into expert survey items and sent to experts for confirmation. The data collection process are same as the step 2.

Data Analysis

The database of expert consultation forms was established, and the returned confirmation form were analyzed statistically.

This step can also feedback on the research methods, assumptions, and limitations of model creation, so that the researchers can identify areas requiring improvement on the accuracy and effectiveness of the model.

The detailed research process of step4 is summarized as shown in Figure 3.5.



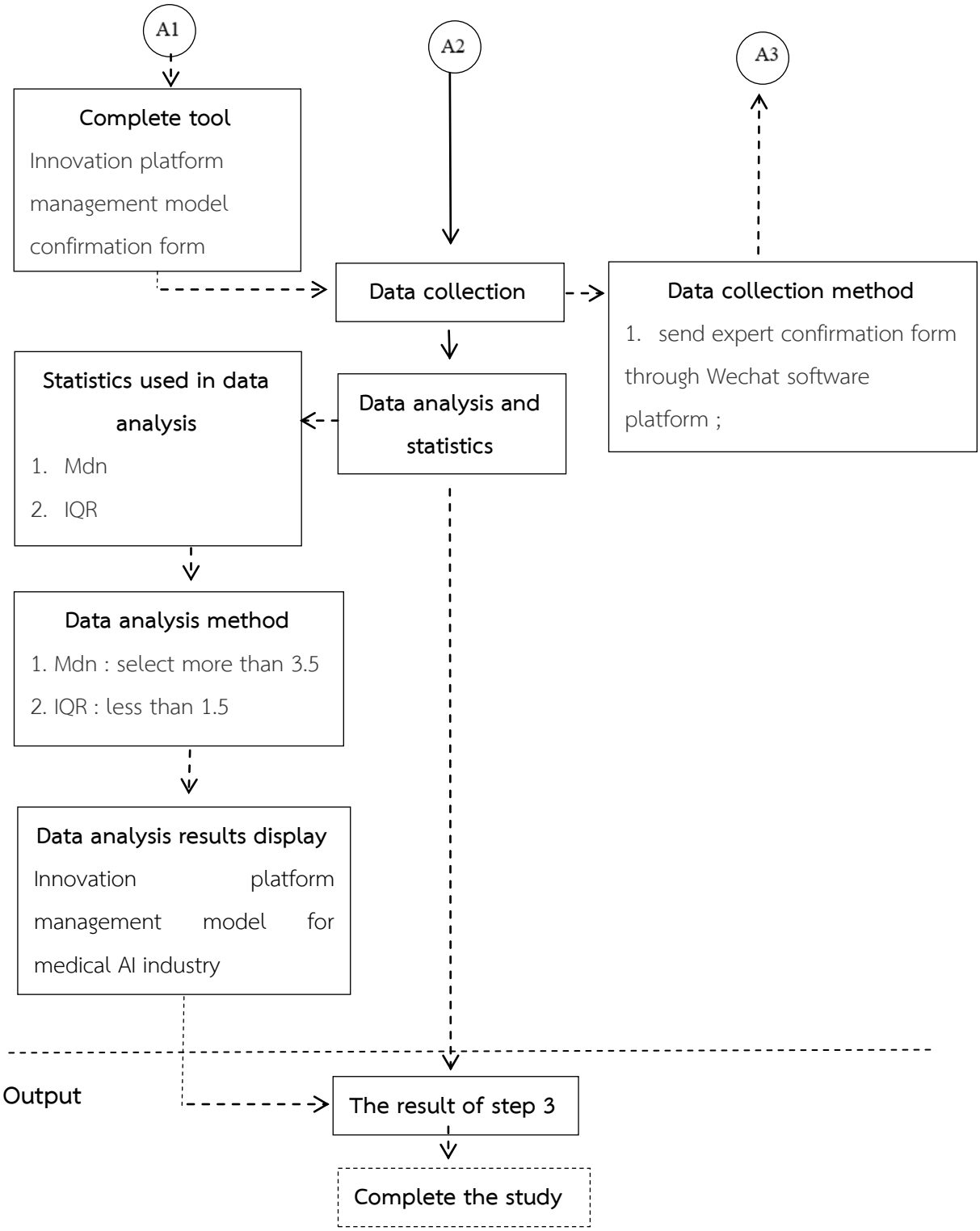


Figure 3.4 Details of the research process step 3

Chapter 4
Results of Analysis

The goal of this study is to explore the possibility of developing a management model of Innovation platform to facilitate the future development of the medical AI industry. The following research question is used to guide the study:

What is the appropriate management model for the innovation platforms to facilitate the future development of medical AI industry?

For the research objectives of development of management model for innovation platform in medical AI industry, this chapter provides the outcomes of data analysis from an in-depth interview, the results of data analysis of an expert evaluation on the management elements, and the results of data analysis from an expert confirmation on the management model. The following abbreviations are adopted for the results display of data analysis.

Mdn refers to the Median

IQR refers to the Inter-Quartile Range

The researcher presents data analysis in three steps as follows.

Step 1 Results of data analysis obtained from in-depth interview to identify the existing problems, opportunities and innovative solutions in medical AI industry.

Step 2 Results of data analysis obtained from experts survey to evaluate the consistency of management elements of innovation platform in medical AI industry.

Step 3 Results of data analysis obtained from experts survey to confirm innovation platform management model for the future development of medical AI industry

Step 1 Results of data analysis obtained from in-depth interview to identify the existing problems, opportunities and innovative solutions in the medical AI industry.

The summary of aspects and themes from the literature review provided the outlines for the in-depth interview that was taken for further exploration of the content of the platform management.

Management Aspects, Themes and Elements from Literature Review

By literature analysis, it is found that the medical AI industry faces a series of problems and challenges in the development process, including data, algorithms, talent, clinical applications, legal responsibilities, and industry regulation. The future development opportunities and trends of the medical AI industry focuses on infrastructure, technological innovation, application scenarios, and policy regulations. To solve the problems encountered in the process of industrial development, the medical AI industry innovation platform provides innovative solutions through resource aggregation, innovation ecology, open sharing, resource allocation,etc.to support innovation activities and accelerate multi-scenario applications

Thus, the analysis data can be summarized into five aspects for innovation platform management:

infrastructure,

technology innovation

application scenario

policies and regulations

platform organization

Under the five management aspects, there are 16 themes and 25 elements as shown in Table 4.1.

Table 4.1 Management Elements

Aspects		Themes	Elements
Problems and Challenges		Medical Data	1) Lack of high quality data 2) Lack of data standards and sharing mechanism
		Algorithm	1) Algorithmic bias 2) Lack of interpretability
		Clinical Applications	1) Product launch approval costs time and money 2) Technology uncertainty and security risks
		Talents	Scarcity of interdisciplinary talents
		Commercialization	Unclear of business model and monetization model
		Ethnics and Law	1) Information security and patient privacy protection 2) Legal system for risk liability and supervision
Opportunities and Trends	Infrastructure	Medical Data	1) Construct medical data standards 2) Protect medical data privacy
		Algorithms	Make the decision-making process fairness, accountability, and transparency
	Technology Innovation	Key Core Technologies	1) Develop AI chips 2) Develop Large AI models
		Innovative Talents	Establish inter-disciplinary talent development system
	Application Scenario	Clinical Applications	1) Meet demands of segmented scenes 2) Form integrated AI solutions for personalized diagnosis and treatment

Table 4.1 (Continued)

Aspects		Themes	Elements
		Commercialization	Build business loop and pilot projects
	Policies and Regulations	Industrial Policies	Provide Industrial policies support
		Ethics and Law	1) Issue regulation on new technologies 2) Establish ethical governance
Innovative Solutions Of Innovation Platform	Platform Organization	Role Positioning	1) Integrate various innovative elements to support innovation activities 2) Accelerate multi-scenario applications
		Development Trend and suggestions	1) Establish organizational structure system and collaborative mechanisms 2) Top-level design and build open innovation ecosystem
Total	**16**	**26**	

The analysis results from the literature review provide the outlines for the in-depth interview that is taken for further exploration of the management elements and supplementary analysis of the key factors that influence the development of the medical AI industry and innovation platform performance.

Participants and Demographics

The five experts for in-depth interview were selected based on the following criteria: has a bachelor degree or above in education; at least 5 years of work experience in medical AI or related field; come from different stakeholders in the medical AI industry. The names and organizations were present anonymously at the request of the interviewee.

There were three parts of data analysis from in-depth interview as follows , namely problems and challenges analysis, opportunities and trends analysis, innovative solutions of innovation platform analysis

1. Results of data analysis of platform management elements in problems and challenges of medical AI industry.

In the in-depth interview, five experts unanimously agreed on the six themes of problems and challenges, namely medical data, algorithm, clinical application, talents and commercialization, ethnics and law under, and they brought many new elements under these themes. There were result of data analysis as shown in table 4.2.

Table 4.2 Results of data analysis of platform management elements in problems and challenges of medical AI industry

No.	Problems and Challenges Analysis	Frequency
	Medical Data	
1	Lack of high quality data	2
2	Lack of data standards and sharing mechanism	5
3	Data privacy protection issues	2
	Algorithm	
4	Without their own core algorithms, most Chinese companies use fine-tuned model on foreign open-source algorithms	4
5	Lack of high-performance computing chips, affecting algorithm innovation and development	1
	Clinical Application	
6	Product launch approval costs time and money	2
7	Poor matching between AI technology and clinical workflow	1
8	problems with the integration of AI technology and clinical demands	1
9	AI products cannot adapt to various application scenarios automatically	2

Table 4.2 (Continued)

No.	Problems and Challenges Analysis	Frequency
10	Lack of clinical performance evaluation system for medical AI product, affecting product approval and application	1
11	Most Medical AI products are still in the research and experimental stage, and there is still a certain gap with clinical applications	1
	Talents	
12	Scarcity of interdisciplinary talents	5
13	Major universities have not yet established interdisciplinary talent training systems	1
14	Its difficult to cultivate interdisciplinary talents of clinical and computer in a short time	1
	Commercialization	
15	Unclear of business model and monetization model	3
16	weak product strength	2
17	Medical inclusive pricing determines a small profit margin for products and lack of reasonable pricing mechanisms to support cost recovery for innovative products	2
	Ethnics and Law	
18	Lagging laws and regulations are unable to effectively support the legal and compliant application of innovative products	4
19	Ethics do not receive as much attention in China as abroad	1
Problems and Challenges Sorting		
20	Talents challenge ranks the most importance among all issues	5
21	Clinical application issues	4
22	Algorithm and core technologies challenges	3
23	Commercialization problems	1
24	laws and regulations issues	1

From Table 4.2, it can be seen that among all the management elements of problems and challenges proposed by experts, there were two elements got the highest frequency of 5 and were recognized by all experts, included element no.2 under medical data: lack of data standards and sharing mechanism and elements no.12: scarcity of interdisciplinary talents. These two elements were regarded as top urgent issues and drawn great attention from experts. The second high frequency were element no.4: without their own core algorithms and most Chinese companies use fine-tuned model on foreign open-source algorithms and element no.18: lagging laws and regulations are unable to effectively support the legal and compliant application of innovative products. These two elements were recognized by 4 experts respectively and regarded as urgent issues to be solved. The third one was element no.15: unclear of business model and monetization model, which was mentioned by 3 experts.

Accordingly, when experts were asked to sort six themes of problems and challenges, talents challenge was ranked the most importance among all themes. It got the highest attention and recognized by 5 experts. The second importance themes was clinical application with a frequency of 4. Algorithm and core technologies challenges as well as commercialization problem were regarded as the third importance, which received 3 experts' comments respectively. However, experts didn't mention medical data when sorting six themes of problems and challenges.

2. Results of data analysis of platform management elements in opportunities and trend of medical AI industry.

In the in-depth interview, five experts unanimously agreed on four aspects and eight themes of opportunities and trend proposed by the researcher. The four aspects were infrastructure, technology innovation, application scenario, policies and regulations. The eight themes were medical data, algorithm, key core technology, innovative talents, clinical application, commercialization, industry polices, ethnics and law. Experts also brought many new elements under these themes. There are results of data analysis as shown in table 4.3.

Table 4.3 Results of data analysis of platform management elements in opportunities and trend of medical AI industry

No.	Opportunities and Trend Analysis	Frequency
Infrastructure Aspect		
	Medical Data	
1	Establish medical data standards and norms	3
2	Form data pools based on the advantages of abundant data and diverse scenarios in China	2
3	Establish a mechanism for medical data integration	1
Infrastructure Aspect		
	Algorithm	
1	Improve algorithm accuracy	3
2	Utilizing open-source algorithms, perform algorithm fine-tuning based on domain-specific data and knowledge.	2
Technology Innovation		
	Key Core Technologies	
1	Develop high-end chips	1
2	Develop large models	2
3	Develop a domain knowledge base in order to unify rules for medical data and research consensus, as knowledge system is the foundation of developing medical AI industry	2
4	Build a knowledge+data dual wheel driven technology platform (technical foundation), coupled with tool chains, to provide services for the industry	1
5	Invest funds, policies, and talents by the government in the research and development of chips, algorithms, and key technologies	2
	Innovative Talents	
1	Establish inter-disciplinary talent development system	2
2	Cultivate interdisciplinary talents in medicine and AI	3

Table 4.3 (Continued)

No.	Opportunities and Trend Analysis	Frequency
3	To shorten the training period for interdisciplinary talents, medical professionals with an interest can be selectively chosen to undergo AI skills training.	1
4	Encourage more people to participate in the medical AI industry, whether through incentive measures or commercial mechanisms	1
5	The State should fund free training class for talents of this field and send people to developed countries for further education and provide full scholarship support	1
Application Scenario		
	Clinical Application	
1	Promote deep integration between clinical demands and AI technology	5
	Commercialization	
1	Innovative products should collaborate with leading enterprises as they understand industry needs, propose standards, and provide market channels	1
2	Directly cooperate with large hospitals would be a better way to commercialize, as commercial resources and timely feedback are more important than others	1
3	The government needs to guide the layout of the industrial chain, encourage a large enterprise to take the lead, and enable other enterprises to do a good job in the upstream and downstream links, forming an ecosystem	1
4	to connect the industrial chain end to end through the integration of industry, academia, and research, each link in the chain having a clear positioning and mutually supportive functions	2

Table 4.3 (Continued)

No.	Opportunities and Trend Analysis	Frequency
Policies and Regulations		
	Industrial Policies	
1	Provide Industrial policies support helping to connect the entire industry chain	5
2	The market needs to have an error-tolerant mechanism in regards to innovation.	2
	Ethics and Law	
1	Provide assistance to medical AI startups in addressing compliance issues	2
2	Policies and regulations should be predictable and sustainable	3
3	Priority should be given to products that have passed project review and approval for entering clinical application	1

From table 4.3, it can be seen that among all elements of opportunities and trend that proposed by experts, there were two elements got the highest frequency of 5, including element no.1 of clinical application: promote deep integration between clinical demands and AI technology and element no. 1 of industry policies: provide industrial policies support helping to connect the entire industry chain. All five experts agreed these two management measures were vital to accelerate the industry development.

There were four elements ranked in the second important place, including element no. 1 of medical data: establish medical data standards and norms, element no.1 of algorithm: improve algorithm accuracy, element no. 2 of innovative talents: cultivate interdisciplinary talents in medicine and AI; and elements no. 2 of ethnics and law: policies and regulations should be predictable and sustainable. They got high frequency and were mentioned by 3 experts respectively.

Took a close look at each aspect of the opportunities and trend, it was found that in infrastructure aspect there were 3 elements under medical data theme and 2 elements under algorithm. Of all the elements, element : to establish medical data

standards and element: norms and to improve algorithm accuracy got the highest frequency and were recognized by 3 experts respectively.

In technology innovation aspect, there were 5 elements under key core technology theme and under innovative talents theme respectively. The elements were diversified and dispersed. Although in the analysis of problems and challenges, the talents challenge drawn all the experts attention, the talents theme in opportunities and trend didn't got the highest frequency of 5. The element of cultivate interdisciplinary talents in medicine and AI under talents theme only mentioned by 3 experts. The rest eight elements in technology innovation aspect got low frequency and were recognized by 1 or 2 experts only. It seemed experts tried to find more solutions for this aspect and had not reached consensus yet.

In application scenario, there were 1 element under clinical application theme and 4 elements under commercialization theme. It is vital to promote deep integration between clinical demands and AI technology. All 5 expects unanimously agreed on this element. However, the elements under commercialization theme were diversified and dispersed. All of them got low frequency and were mentioned by 1 or 2 experts only.

In policies and regulations aspect, there were 2 elements under industry policies theme and 3 elements under ethnics and law theme. All five expects unanimously agreed that providing industrial policies support helping to connect the entire industry chain would be the solution to the industry development. Another element that policies and regulations should be predictable and sustainable also got high frequency and were mentioned by 3 experts. The rest elements were mentioned by 1 or 2 experts only.

3. Results of data analysis of management elements in innovative solutions of innovation platform in medical AI industry

In the in-depth interview, 5 experts unanimously agreed on two themes of platform organization aspect of innovative solutions proposed by the researcher. There are data analysis of innovative solutions of innovation platform as shown in table 4.4.

Table 4.4 Results of data analysis of management elements in innovative solutions of innovation platform in medical AI industry

No.	Innovative Solutions Analysis	Frequency
	Role Positioning	
1	**Connecting and sharing**	2
2	The platform needs to have a clear positioning for what it can provide	3
	Development Trends and Suggestions	
1	Establish organizational structure system and collaborative mechanisms	4
2	Top-level design and build open innovation ecosystem	1
3	Develop its own underlying algorithms and large model for industry use	2
4	Incubate startups with core technologies and provide policy implementation to support the growth of startups	1
5	Provide clinical resources and application scenario	1
6	Provide commercialization and promotion supports	2

From table 4.4, it can be seen that in platform organization aspect, there were 2 elements under role positioning and 6 elements under development trends and suggestions theme. 3 experts thought the platform needed to have a clear positioning for what it could provide. For the development trend and suggestions, the element of establishing organizational structure system and collaborative mechanisms got the highest frequency and were mentioned by 3 experts. Other five elements under development trends and suggestions theme were diversified and dispersed, mentioned by 1 or 2 experts. It seemed that experts hoped to find more solutions but had not reached consensus yet.

The researcher got other suggestion from the interviewee for the study that medical industry was highly specialized and policy driven, so further specialized

research was needed. The researcher would take it into consideration if there was further research.

4. Summary of management elements based on literature review and in-depth interview

From results of data analysis of in-depth interview, it can be see that the experts have expanded and supplemented many new elements for the themes. All the elements identified from both literature review and in-depth interview were used as the management elements for innovation platform. Then, the researcher makes a summary of the two batches of elements, gets 5 aspects, 10 themes and 41 elements for innovation platform management in medical AI industry as shown in table 4.5.

Table 4.5 Summary of Management Elements based on Literature Review and In-depth Interview

Aspects	Themes	Elements
Infrastructure	Medical Data	1) Establish medical data standards and norms
		2) Protect medical data privacy
		3) Form data pools and industry consensus
		4) Establish a mechanism for medical data integration
	Algorithms	1) Make the decision-making process fairness, accountability and transparency
		2) Improve algorithm accuracy
		3) Fine tune algorithms based on domain data and knowledge
Technology Innovation	Key Core Technologies	1) Develop high-end chips
		2) Develop Large models
		3) Develop a domain knowledge base in order to unify rules for medical data and research consensus, as knowledge system is the foundation of developing medical AI industry

Table 4.5 (Continued)

Aspects	Themes	Elements
		4) Build a knowledge+data dual wheel driven technology platform (technical foundation), coupled with tool chains, to provide services for the industry 5) Invest funds, policies, and talents by the government in the research and development of chips, algorithms, and key technologies
Technology Innovation	Innovative Talents	1) Establish inter-disciplinary talent development system 2) Cultivate interdisciplinary talents in medicine and AI 3) To shorten the training period for interdisciplinary talents, medical professionals with an interest can be selectively chosen to undergo AI skills training. 4) Encourage more people to participate in the medical AI industry, whether through incentive measures or commercial mechanisms 5) The State should fund free training class for talents of this field and send people to developed countries for further education and provide full scholarship support
Application Scenarios	Clinical Applications	1) Meet demands of segmented scenes 2) Form integrated AI solutions for personalized diagnosis and treatment 3) Promote deep integration between clinical demands and AI technology
	Commercialization	1) Build business loop and pilot projects 2) Innovative products should collaborate with leading enterprises as they understand industry needs, propose standards, and provide market channels 3) Directly cooperating with large hospitals would be a better way to commercialize, as commercial resources and timely feedback are more important than others

Table 4.5 (Continued)

Aspects	Themes	Elements
		4) The government needs to guide the layout of the industrial chain, encourage a large enterprise to take the lead, and enable other enterprises to do a good job in the upstream and downstream links, forming an ecosystem 5) To connect the industrial chain end to end through the integration of industry, academia, and research, each link in the chain having a clear positioning and mutually supportive functions
Policies and Regulations	Industrial Policies	1) Provide Industrial policies support helping to connect the entire industry chain 2) The market needs to have an error-tolerant mechanism in regards to innovation.
	Ethics and Law	1) Issue regulation on new technologies 2) Establish ethical governance 3) Provide assistance to medical AI startups in addressing compliance issues 4) Policies and regulations should be predictable and sustainable 5) Priority should be given to products that have passed project review and approval for entering clinical application
Platform Organization	Role Positioning	1) Integrate various innovative elements to support innovation activities 2) Accelerate multi-scenario applications 3) Connecting and sharing
	Development Trends and Suggestions	1) Establish organizational structure system and collaborative mechanisms 2) Top-level design and build open innovation ecosystem 3) Develop its own underlying algorithms and large model for industry use

Table 4.5 (Continued)

Aspects	Themes	Elements
		4) Incubate startups with core technologies and provide policy implementation to support the growth of startups
		5) Provide clinical resources and application scenario
		6) Provide commercialization and promotion supports
5 aspects	**10 themes**	**41 elements**

Step 2 Results of data analysis obtained from experts survey, to evaluate the consistency of management elements of innovation platform in medical AI industry

An expert confirmation process is utilized to evaluate the consistency of management elements of innovation platform in medical AI industry by surveying 17 experts from the stakeholders of this industry in China. Results of conformity evaluation by experts including improving management elements of innovation platform in medical AI industry. This chapter concludes with a summary of findings.

Participants and Demographics

For the expert confirmation process, 17 experts were selected as the minimum sample size. The criteria that were developed for selecting experts include the following:

(1) A minimum of Bachelor degree in education;

(2) A minimum of 5 years experience in medical AI or related field;

(3) Experts from different stakeholders of the medical AI industry.

All 17 participating experts identity remained anonymous to prevent bias. For the researcher to preserve anonymity throughout the research, each participant created a nameless personal identity code to use in place of personal information.

An examination of the demographics of the experts selected for this study revealed that the average experience of the experts in medical AI field was 15 years with a range of 5 to 24 years. The types of profession varied among the participants, and the calculations for experts profession were: 5 clinical medicine and related field, 4 computer science, 3 information engineering, 2 AI and medical AI, 2 public

administration, and 1 physics. The data showed 6 experts came from medical AI start-ups, 3 from listed company, 3 from investor, 2 from university, 2 from hospital and 1 from government department. All these organizations were the stakeholders of the medical AI industry. The data also showed all the experts held senior leadership roles (i.e., directors or higher) in the organizations. The dispersion of work organization and the diversity of knowledge and position was considered to provide different perspectives for this study.

From the analysis and consistent evaluation of management elements by 17 experts to find the median (Mdn) and inter-quartile range (inter-quartile range: IQR) on a per item basis, the data analysis results were presented as table 4.6.

Table 4.6 Median and inter-quartile range in the evaluation of management elements of innovation platform in medical AI industry.

No.	Evaluation Elements	Mdn	IQR
Infrastructure Aspect			
	Medical Data		
1	Establish medical data standards and norms	4.0	1.0
2	Protect medical data privacy	5.0	1.0
3	Form data pools and industry consensus	4.0	1.0
4	Establish a mechanism for medical data integration	4.0	0
	Algorithms		
1	Make the decision-making process fairness, accountability and transparency	4.0	1.0
2	Improve algorithm accuracy	4.0	1.0
3	Utilizing open-source algorithms, perform algorithm fine-tuning based on domain-specific data and knowledge.	4.0	1.0
Technology Innovation Aspect			
	Key Core Technologies		
1	Develop high-end chips	2.0	1.0
2	Develop Large models	3.0	1.0

Table 4.6 (Continued)

No.	Evaluation Elements	Mdn	IQR
3	Develop a domain knowledge base in order to unify rules for medical data and research consensus, as knowledge system is the foundation of developing medical AI industry	5.0	1.0
4	Build a knowledge+data dual wheel driven technology platform (technical foundation), coupled with tool chains, to provide services for the industry	4.0	1.0
5	Invest funds, policies, and talents by the government in the research and development of chips, algorithms, and key technologies	4.0	2.0
	Innovative Talents		
1	Establish inter-disciplinary talent development system	4.0	1.0
2	Cultivate interdisciplinary talents in medicine and AI	5.0	1.0
3	To shorten the training period for interdisciplinary talents, medical professionals with an interest can be selectively chosen to undergo AI skills training.	4.0	1.0
4	Encourage more people to participate in the medical AI industry, whether through incentive measures or commercial mechanisms	4.0	1.0
5	The State should fund free training class for talents of this field and send people to developed countries for further education and provide full scholarship support	3.0	2.0
Application Scenario Aspect			
	Clinical Applications		
1	Meet demands of segmented scenes	5.0	1.0
2	Form integrated AI solutions for personalized diagnosis and treatment	4.0	2.0
3	Promote deep integration between clinical demands and AI technology	5.0	1.0

Table 4.6 (Continued)

No.	Evaluation Elements	Mdn	IQR
	Commercialization		
1	Build business loop and pilot projects	5.0	1.0
2	Innovative products should collaborate with leading enterprises as they understand industry needs, propose standards, and provide market channels	4.0	0
3	Directly cooperating with large hospitals would be a better way to commercialize, as commercial resources and timely feedback are more important than others	4.0	1.0
4	The government needs to guide the layout of the industrial chain, encourage a large enterprise to take the lead, and enable other enterprises to do a good job in the upstream and downstream links, forming an ecosystem	4.0	1.0
5	to connect the industrial chain end to end through the integration of industry, academia, and research, each link in the chain having a clear positioning and mutually supportive functions	4.0	2.0
Policy and Regulation Aspect			
	Industrial Policies		
1	Provide Industrial policies support helping to connect the entire industry chain	4.0	2.0
2	The market needs to have an error-tolerant mechanism in regards to innovation.	4.0	1.0
	Ethics and Law		
1	Issue regulation on new technologies	4.0	2.0
2	Establish ethical governance	4.0	1.0
3	Provide assistance to medical AI startups in addressing compliance issues	4.0	1.0
4	Policies and regulations should be predictable and	4.0	1.0

Table 4.6 (Continued)

No.	Evaluation Elements	Mdn	IQR
	sustainable		
5	Priority should be given to products that have passed project review and approval for entering clinical application	5.0	1.0
Platform Organization Aspect			
	Role Positioning		
1	Integrate various innovative elements to support innovation activities	4.0	1.0
2	Accelerate multi-scenario applications	4.0	1.0
3	Connecting and sharing	4.0	0
	Development Trend and Suggestions		
1	Establish organizational structure system and collaborative mechanisms	4.0	1.0
2	Top-level design and build open innovation ecosystem	4.0	1.0
3	Develop its own underlying algorithms and large model for industry use	5.0	1.0
4	Incubate startups with core technologies and provide policy implementation to support the growth of startups	4.0	1.0
5	Provide clinical resources and application scenario	5.0	1.0
6	Provide commercialization and promotion supports	5.0	1.0

It was found from Table 4.6 that there were 8 items with a median value of 3.0 and below or an inter-quartile range of 2 and above. It indicated these elements were general or less important, or the consistency of expert evaluations of the importance of them were general or low. These 8 items should be removed and there were 33 items left. The results of data analysis were illustrated as below.

Infrastructure Aspect

All 7 items had a median value of 4.0 and above and a inter-quartile range of 1.0 and below. This means that in terms of medical data and algorithm, there was a concentration of expert opinions and consistent evaluations, all of which considered

them very important. The item with the highest median value (Mdn=5.0) was that Protect medical data privacy, which meant privacy protection was considered the most important. The lowest inter-quartile range (IQR=0) went to the item Establish a mechanism for medical data integration, which indicated medical data integration had received unanimous recognition from experts. Other elements were considered very important and attached the vast majority of experts attention, such as Establish medical data standards and norms, Form data pools and industry consensus for medical data, and elements such as Make the decision-making process fairness, accountability and transparency, Improve algorithm accuracy, Utilizing open-source algorithms, perform algorithm fine-tuning based on domain-specific data and knowledge for algorithm.

Technology Innovation Aspect

In this section, 4 items with a median value of 3.0 and below or an inter-quartile range of 2.0 should be removed. There were only 6 items left. This meant for management elements in terms of technology innovation and innovative talents, expert opinions were not as concentrated, and evaluations were not as consistent. It was because the development of high-end chips and large models were challenging but controversial. It requires a large amount of capital and talent with a long cycle, which requires overall planning at the national level and cannot be solved at the innovation platform level. The items with the highest median value (Mdn=5.0) were Develop a domain knowledge base in order to unify rules for medical data and research consensus, as knowledge system is the foundation of developing medical AI industry and Cultivate interdisciplinary talents in medicine and AI, which meant domain knowledge base and interdisciplinary talents in medicine and AI were considered the most important. The other elements such as technical foundation, talent development system, training selected doctor, and measures to attract more talents also received high recognition from experts.

Application Scenario Aspect

In this section, 2 items with a median value of 4.0 but an inter-quartile range of 2.0 were removed. It means elements with regard to connection of industrial chain and formation of integrated AI solutions were important but controversial. There were 3 items with the highest median value (Mdn=5.0), namely Meet demands of segmented scene, Promote deep integration between clinical demands and AI

technology, Build business loop and pilot projects. It could be seen that clinical application was considered the most important, because only by finding application scenarios could we promote the innovation and development of medical AI in turn. On the other hand, how to develop business loop and carry on pilot projects were vital to facilitate commercialization of medical AI. Other elements such as collaboration with leading enterprises and big hospital, layout of industrial chain were also received high recognition from experts.

Policy and Regulation Aspect

There were 2 items with a median value of 4.0 but an inter-quartile range of 2.0 in this section too. It means the polices for connection industrial chain and new technology were important but not in accordance with the opinions of majority experts. The item with the highest median value (Mdn=5.0) was Priority should be given to products that have passed project review and approval for entering clinical application, which meant that establishing a fast track for new products to enter clinical applications was the most important. On the other hand, policy consistency, stability, and predictability were considered very important, which involved two elements. Here the majority of experts also paid much attention to the element of The market needs to have an error-tolerant mechanism in regards to innovation with a medium value of 4.0 and a inter-quartile range of 1.5

Platform Organization Aspect

All 9 items had a median value of 4.0 and above and a inter-quartile range of 1.5 and below. This means that in terms of role positioning and development trend of platform organization, there was a concentration of expert opinions and consistent evaluations, all of which considered them very important. There were 3 items with the highest median value (Mdn=5.0), namely Develop its own underlying algorithms and large model for industry use, Provide clinical resources and application scenario, Provide commercialization and promotion supports. clinical resources, scenarios, commercialization supports, underlying algorithms and large model for medical AI industry are regarded as the most important. The lowest inter-quartile range (IQR=0) went to the item of Connecting and sharing for role positioning, which indicated platform role position had received unanimous recognition from experts. The other elements such as organizational structure system, collaborative mechanisms, open

innovation ecosystem and innovation activity supports were highly recognized by the majority of experts.

From additional comments and suggestions from the evaluation, it was found that over 70% experts suggested to add computing power theme in infrastructure aspect, including new elements such as Introduce cloud service providers or construct public computing power supply to reduce research and development costs within the platform, through purchasing computing power to comprehensively enhance the platform's innovation capabilities and empower medical start-ups and other entities on the platform. They were summarized and added as shown in table 4.7.

Table 4.7 New Theme and Elements added to Infrastructure Aspect

No.	Original Elements	New Elements
	Medical Data	**Medical Data**
1	Establish medical data standards and norms	Establish medical data standards and norms
2	Protect medical data privacy	Protect medical data privacy
3	Form data pools and industry consensus	Form data pools and industry consensus
4	Establish a mechanism for medical data integration	Establish a mechanism for medical data integration
	Algorithms	**Algorithms**
1	Make the decision-making process fairness, accountability and transparency	Make the decision-making process fairness, accountability and transparency
2	Improve algorithm accuracy	Improve algorithm accuracy
3	Utilizing open-source algorithms, perform algorithm fine-tuning based on domain-specific data and knowledge.	Utilizing open-source algorithms, perform algorithm fine-tuning based on domain-specific data and knowledge.

Table 4.7 (Continued)

No.	Original Elements	New Elements
		Computing Power
1		Introduce cloud service providers or construct public computing power supply to reduce research and development costs within the platform
2		Through purchasing computing power to comprehensively enhance the platform's innovation capabilities and empower medical start-ups and other entities on the platform

According to the expert's opinions, the management elements of innovation platform were revised. There were 35 management elements in totally.

Through the second step of research, the management elements of innovation platform in medical AI industry were evaluated and further confirmed by experts. In the next step, the model design, model interpretation and model evaluation were carried out based on the obtained management elements.

Step 3 Results of data analysis obtained from experts survey, to confirmation innovation platform management model for the future development of medical AI industry

1. Management Model Creation and Illustration

According to the research results of Step 1 and Step 2, a management model for innovation platform in medical AI industry was created. This model consisted of five management aspects, namely infrastructure, technology innovation, application scenario, policy and regulation, platform organization, and 11 management themes, including medical data, algorithms, computing power, key core technologies,

innovation talents, clinical application, commercialization, industrial policy, ethnics and law, role positioning and development goal. The details of the management model are as fig 4.1.

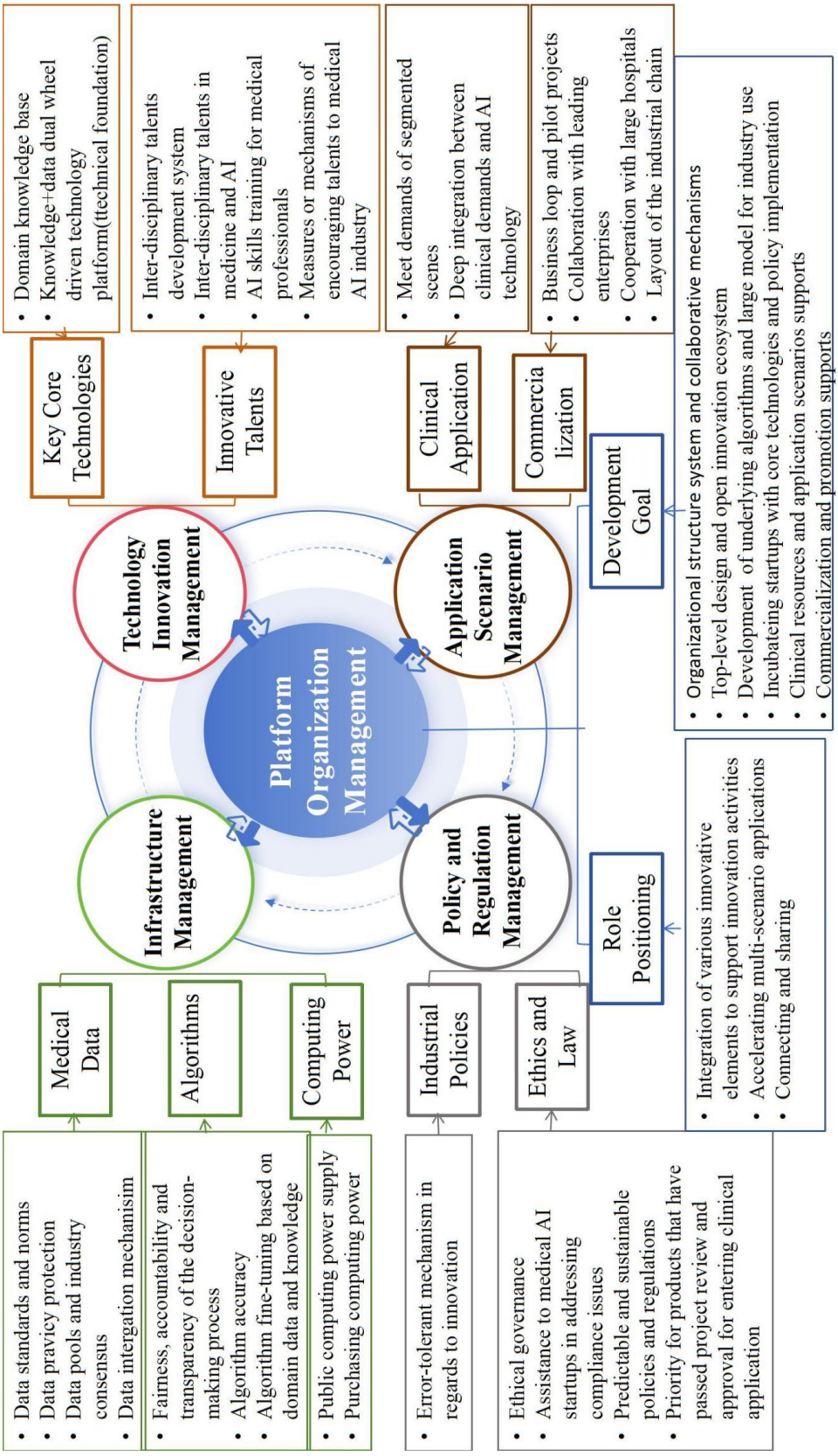


Figure 4.1 Management Model of Innovation Platform in Medical AI Industry

The management model of innovation platform in the medical AI industry presented in Figure 4.1 offers a multifaceted framework that encompasses five management aspects, 11 management themes and 35 management elements. These components work together to foster a robust organic system for innovation and growth within the medical AI sector.

Infrastructure Management

Infrastructure management serves as the foundational layer and starting point of this model for the development and deployment of medical AI solutions. It is composed of three themes: medical data, algorithms, and computing power.

The quality, quantity, and diversity of medical data available are crucial factors that determine the efficacy of AI models. Data standards and norms are essential for ensuring consistency and comparability across different datasets. Privacy protection is another critical element, as sensitive patient information must be handled with utmost confidentiality and in accordance with regulations in China. Data pools and industry consensus are also important for fostering collaboration between different organizations and promoting the sharing of knowledge. Finally, data integration mechanisms are necessary to allow disparate data sources to be combined seamlessly, enabling a more complete view of patient health and care.

Algorithms are the cognitive engines that enable AI systems to learn from data and make decisions. The management of algorithms involves fairness, accountability, and transparency, especially when algorithms are used in decision-making processes that affect patient care. Ensuring that algorithms do not perpetuate biases or discriminate against certain groups is a continuous challenge that requires diligent monitoring and evaluation. Algorithm accuracy is another critical aspect, as even small errors can have significant consequences in a clinical setting. Fine-tuning the algorithm of open source large models based on domain data and knowledge can avoid duplication of work and stand on the shoulders of predecessors to further improve and promote the development of AI.

Computing power is the physical resource that enables the processing and analysis of large volumes of medical data. As AI models become increasingly complex, requiring more computational resources to train and execute, having adequate computing power becomes a strategic consideration. This involves purchasing computing power, introducing or building public computing power supply.

Technology Innovation Management

Technology innovation is the engine that drives the entire medical AI ecosystem, with a focus on the continuous advancement of key core technologies and cultivation of innovation talents. The technology Innovation management is critical for maintaining a competitive edge and driving progress toward improved medical care. It encompasses two themes: key core technologies and innovation talents.

Key core technologies such as machine learning, natural language processing, and computer vision, are the foundation upon which all AI-driven medical innovations are built. The management elements that contribute to the development of key core technologies include a deep domain knowledge base, which ensures that AI solutions are developed by a thorough understanding of medical principles and practices. Additionally, the knowledge+data dual wheel-driven technology platform provides a technical foundation necessary for integrating domain expertise with data-driven insights. This platform serves as the backbone for developing AI algorithms that can effectively address complex medical challenges.

Innovation talents are the driving force behind the development and implementation of AI technologies in medical sector. The quality and quantity of inter-disciplinary innovative talents available are crucial factors. A robust inter-disciplinary talents development system is essential for cultivating individuals who possess both the medical expertise and AI proficiency needed to navigate this rapidly evolving field. Encouraging collaboration between experts in medicine and AI is crucial for fostering innovative thinking and generating new solutions. Furthermore, providing AI skills training for medical professionals who express an interest in these technologies can help bridge the gap between these two domains. Measures or mechanisms that encourage talents to enter the medical AI industry, such as educational programs, research opportunities, and career incentives, are vital for attracting and retaining individuals who will drive the future medical AI innovation.

Application Scenarios Management

Application scenarios are where the real-world value of medical AI is realized. application scenarios management plays a pivotal role in ensuring the translation of theoretical advancements and research breakthroughs into tangible benefits for patients and medical care providers. This management is concerned with the

practical implementation of AI technologies within clinical settings and their successful commercialization. It encompasses two themes: clinical application and commercialization.

Clinical application is the process through which AI technologies are integrated into daily work flow and medical practice, enhancing the quality of medical care and improving patient outcomes. The management elements that facilitate this process include meeting the demands of segmented scenes, where AI solutions are tailored to specific clinical areas such as radiology, pathology, or cardiology. A deep integration between clinical demands and AI technology is essential, ensuring that the tools developed address real-world challenges faced by medical care professionals. This requires ongoing communication between developers and clinicians to ensure that technological solutions remain grounded in medical reality and usability.

Commercialization, on the other hand, involves the transformation of medical AI technologies into viable products and services that can be widely adopted across the medical industry. It includes several management elements, such as the establishment of a business loop that ensures a consistent flow of ideas, funding, and resources to support the development and marketing of medical AI solutions. Pilot projects are used to demonstrate the feasibility and effectiveness of new technologies in real-world settings, providing valuable data that supports further investment and scale-up. Collaboration with leading enterprises and large hospitals can facilitate access to expertise, resources, and potential markets, while also offering opportunities for joint research and development. Additionally, a strategic layout of the medical industrial chain is crucial for identifying potential partners, suppliers, and distributors, connecting upstream and downstream, ensuring that the commercialization process is efficient and sustainable.

Policy and Regulation Management

Policy and regulation management is responsible for creating an environment that fosters innovation while ensuring ethical conduct and compliance with legal frameworks. It encompasses two key themes: industrial policy and ethics and law.

Industrial policy is a critical component that guides the growth and development of the medical AI industry. China needs industrial policies management that promote a culture of innovation while being forgiving of honest mistakes set the

stage for groundbreaking advancements. Effective industrial policy include error-tolerant mechanisms in regards to innovation. These mechanisms provide a buffer for companies to experiment and push the boundaries of what is possible without the fear of excessive legal repercussions for unintended errors. Industrial policies also include subsidies and incentives mechanism to encourage industrial funds and venture capital funds to invest in early-stage and seed-stage projects, so that these emerging technologies have the opportunity to receive financial support and gain opportunities for germination and growth at the seed stage. Such policies encourage a culture of risk-taking and innovation, which are essential for driving progress in complex fields like medical AI.

Ethics and law are equally important themes that ensure the responsible use of AI in medical practise. Ethical governance is a cornerstone of this theme, as it involves establishing principles and standards that dictate how AI should be developed and used in medical care. This includes considerations around patient privacy, data security, and the potential biases that AI systems may perpetuate. Assistance to medical AI startups in addressing compliance issues is another key element, providing guidance and resources to help these companies navigate the complex regulatory landscape. Predictable and sustainable policies and regulations are necessary for maintaining a stable environment that allows businesses to plan for the long term. Finally, prioritizing products that have passed project review and approval for entering clinical application helps to ensure that only well-vetted and safe technologies are made available to patients and providers. It also can significantly reduce business operating costs and shorten commercialization time.

Platform Organization Management

Innovation platform plays a role of connector, enabler, toolbox that holds the entire system together. Platform organization management involves identifying the platform's unique value proposition, and outlining a road map for achieving its goals. It also involves the creation of an overarching structure that facilitates collaboration between various stakeholders, including researchers, developers, clinicians, and investors. The platform should be designed to promote open innovation, encourage technology and knowledge sharing, empower the participants in the platform and provide access to the resources and expertise needed to drive

innovation forward. The platform organization management encompasses two key themes: role positioning and development trend.

Role positioning is concerned with how the innovation platform defines its role within the medical AI innovation ecosystem. The management elements that contribute to effective role positioning include how the platform integrates various innovative elements to support innovation activities, and how the platform accelerates multi-scenario applications, which involves identifying and developing AI solutions for diverse clinical contexts. Connecting and sharing are also essential, as they facilitate collaboration between different stakeholders, including researchers, clinicians, and industry partners. By creating a platform that encourages openness and information exchange, the platform can become a hub of innovation, where ideas are nurtured and shared, leading to faster progress and better outcomes for the industry development.

Development trend management is the second theme, which focuses on the strategic direction and long-term vision of the platform. The elements that manage these trends include the organizational structure system and collaborative mechanisms. A well-designed structure ensures that the platform can effectively manage resources, coordinate activities, and align the efforts of all participants towards a common vision. Top-level design and an open innovation ecosystem are crucial for establishing a long-term strategy that encourages external contributions and fosters a culture of continuous improvement. Development of underlying algorithms and large models for industry use provides the platform with a technology empowerment capability, making it an enabler to offer cutting-edge technologies and high-quality services that meet the evolving needs of the medical AI industry.

Incubating startups with core technologies and policy implementation is another key element of the development trend management. By providing a supportive environment for emerging companies, the platform can help drive innovation and bring new ideas to market. Providing clinical resources and application scenarios allows these startups to test and refine their products in real-world settings, increasing the likelihood of successful commercialization. Additionally, offering commercialization and promotion supports helps these companies navigate the complexities of the medical AI market, accelerating their growth and impact.

2. Management Model Confirmation

In order to further confirm the management model of innovation platform that created in this step, the researcher adopted an expert confirm process to confirm the model. Five experts was invited to find the median (Mdn) and inter-quartile range (inter-quartile range: IQR) on a per item basis, the results of the data analysis were presented in the table 4.8.

Table 4.8 Median and inter-quartile range in the confirmation of management model of innovation platform in medical AI industry

No.	Evaluation Elements	Mdn	IQR
Infrastructure Management			
	Medical Data		
1	Establish medical data standards and norms	5	1
2	Protect medical data privacy	5	1
3	Form data pools and industry consensus	4	1
4	Establish a mechanism for medical data integration	5	1
	Algorithms		
1	Make the decision-making process fairness, accountability and transparency	5	0
2	Improve algorithm accuracy	5	0
3	Utilizing open-source algorithms, perform algorithm fine-tuning based on domain-specific data and knowledge.	5	0
	Computing Power		
1	Introduce cloud service providers or construct public computing power supply to reduce research and development costs within the platform	5	0
2	Through purchasing computing power to comprehensively enhance the platform's innovation capabilities and empower medical start-ups and other entities on the platform	5	0

Table 4.8 (Continued)

No.	Evaluation Elements	Mdn	IQR
Technology Innovation Management			
	Key Core Technologies		
1	Develop a domain knowledge base in order to unify rules for medical data and research consensus, as knowledge system is the foundation of developing medical AI industry	5	1
2	Build a knowledge+data dual wheel driven technology platform (technical foundation), coupled with tool chains, to provide services for the industry	5	0
	Innovative Talents		
1	Establish inter-disciplinary talent development system	4	1
2	Cultivate interdisciplinary talents in medicine and AI	5	1
3	To shorten the training period for interdisciplinary talents, medical professionals with an interest can be selectively chosen to undergo AI skills training.	4	0
4	Encourage more people to participate in the medical AI industry, whether through incentive measures or commercial mechanisms	5	0
Application Scenario Management			
	Clinical Applications		
1	Meet demands of segmented scenes	5	0
2	Promote deep integration between clinical demands and AI technology	5	0
	Commercialization		
1	Build business loop and pilot projects	4	1
2	Innovative products should collaborate with leading enterprises as they understand industry needs, propose standards, and provide market channels	4	1

Table 4.8 (Continued)

No.	Evaluation Elements	Mdn	IQR
3	Directly cooperating with large hospitals would be a better way to commercialize, as commercial resources and timely feedback are more important than others	4	0
4	The government needs to guide the layout of the industrial chain, encourage a large enterprise to take the lead, and enable other enterprises to do a good job in the upstream and downstream links, forming an ecosystem	4	0
Policy and Regulation Management			
	Industrial Policies		
1	The market needs to have an error-tolerant mechanism in regards to innovation.	5	0
	Ethics and Law		
1	Establish ethical governance	4	1
2	Provide assistance to medical AI startups in addressing compliance issues	5	1
3	Policies and regulations should be predictable and sustainable	5	0
4	Priority should be given to products that have passed project review and approval for entering clinical application	5	1
Platform Organization Management			
	Role Positioning		
1	Integrate various innovative elements to support innovation activities	5	1
2	Accelerate multi-scenario applications	5	0
3	Connecting and sharing	5	1

Table 4.8 (Continued)

No.	Evaluation Elements	Mdn	IQR
	Development Trend and Suggestions		
1	Establish organizational structure system and collaborative mechanisms	4	0
2	Top-level design and build open innovation ecosystem	5	0
3	Develop its own underlying algorithms and large model for industry use	5	1
4	Incubate startups with core technologies and provide policy implementation to support the growth of startups	5	0
5	Provide clinical resources and application scenario	5	1
6	Provide commercialization and promotion supports	5	1

From Table 4.8 results of expert confirmation of management model for innovation platform medical AI industry in accordance with the opinions of experts. All the items with a median value of 3.50 and above and an inter-quartile range of 1.50 and below, so the management model was confirmed.

It is worth noting that the model has been newly created without any reference to other models. It provides a solid model foundation for future in-depth research in this field.

Guidelines for the management model

The management model presents a comprehensive framework for the innovation platform in the medical AI industry. This model is characterized by its multidimensional nature, incorporating five distinct management aspects, eleven management themes, and a total of 35 individual management elements. Collectively, these components collaborate to cultivate a resilient and dynamic ecosystem conducive to sustained innovation and growth. The detailed guidelines for implementing the management model and its elements in practical settings are as follows:

(1) Define and Design Platform Organization

Identify the platform's unique value proposition and develop a road map to achieve its objectives. Create an overarching structure that facilitates collaboration among researchers, developers, clinicians, investors, and other stakeholders. Design the platform to promote open innovation, technology and knowledge sharing, participant empowerment, startups incubation with key core technologies, and access to resources and expertise within the platform, holding the entire medical AI innovation ecosystem together and driving its growth and success.

(2) Build Infrastructure

Ensure the availability of high-quality, diverse, and sufficient medical data for AI model development. Establish data standards and norms for consistency and comparability across datasets. Implement strict privacy protection measures in line with Chinese regulations to safeguard sensitive patient information. Develop robust data integration mechanisms, fostering data pooling and industry consensus to encourage collaboration and knowledge sharing among organizations.

Prioritize fairness, accountability, and transparency in algorithm design, particularly for decision-making processes affecting patient care. Continuously monitor and evaluate algorithms to prevent bias, discrimination, and ensure algorithmic fairness. Maintain high levels of algorithm accuracy, utilize open-source large models and fine-tune them with domain data and knowledge to enhance efficiency and innovation.

Secure adequate computing resources to accommodate the increasing complexity and computational demands of AI models. Strategically acquire computing power through purchases, public computing power supply introduction, or in-house infrastructure development.

(3) Promote Technology Innovation

Focus on continuous advancement of key core technologies, such as machine learning, natural language processing, and other relevant technologies. Develop a deep domain knowledge base to ground AI solutions in sound medical principles and practices. Establish a knowledge+data dual wheel-driven technology platform to integrate domain expertise with data-driven insights, serving as the foundation for AI algorithm development.

Cultivate interdisciplinary talent with both medical expertise and AI proficiency through dedicated development systems. Promote collaboration between medical and AI experts to stimulate innovative thinking and generate novel solutions. Provide AI skills training for interested medical professionals to bridge the gap between the two domains. Implement measures (e.g., educational programs, research opportunities, career incentives) to attract and retain talented individuals in the medical AI industry.

(4) Expand Application Scenarios

Tailor AI solutions to meet the demands of specific clinical segments (radiology, pathology, cardiology, etc.) for seamless integration into daily workflows and improved patient outcomes. Maintain deep integration between clinical demands and AI technology through ongoing communication between developers and clinicians.

Focus on establishing business loops to support the medical AI solution development and marketing. Conduct pilot projects to demonstrate feasibility and effectiveness in real-world settings, informing further investment and scale-up decisions. Collaborate with leading enterprises and large hospitals for expertise, resources, potential markets, and joint R&D opportunities. Strategically layout the medical industrial chain to identify and connect with partners, suppliers, and distributors for efficient and sustainable commercialization.

(5) Create Policy and Regulation Environment

Implement policies that foster a culture of innovation and tolerance for honest mistakes in the pursuit of groundbreaking advancements. Offer subsidies and incentives to encourage investment in early-stage and seed-stage medical AI projects, facilitating their germination and growth.

Establish ethical governance principles and standards for the development and use of AI in medical care, addressing patient privacy, data security, and algorithmic bias. Provide assistance to medical AI startups in navigating compliance issues, ensuring they understand and adhere to regulatory requirements. Maintain predictable and sustainable policies and regulations to create a stable environment for long-term business planning. Prioritize products that have undergone rigorous review and approval processes for clinical application, ensuring safety and reducing operational costs and commercialization time.

(6) Conduct performance Evaluation

Conduct evaluation on the effectiveness of the platform's role positioning and its influence on medical AI innovation, on the progress of technology development and talent cultivation, on the effectiveness of AI integration in clinical settings and the impact of industrial policies on innovation and make necessary adjustments.

Take assessment of the efficiency of the collaborative structure and mechanisms, the commercial viability of AI products and services and the capacity of infrastructure and make modifications if needed,

Monitor the progress of incubated startups and the real-world testing of their products. Review algorithm accuracy and make necessary adjustments. Analyze the stability of the policy environment and make changes for long-term sustainability.

If strategies are effective, standardize and scale successful practices across the industry. If challenges are identified, revisit the planning stage and adjust strategies accordingly.

(7) Continuous Improvement

By applying the PDCA framework (Plan-Do-Check-Act) to each aspect of the platform management, the innovation platform can continuously improve its processes and performance, facilitating the innovation and growth of medical AI industry.

Chapter 5

Conclusion, Discussion and Recommendations

Conclusion

The objectives of this research are:

1. To analyze the existing problems, opportunities and innovative solutions in the medical AI industry.

2. To evaluate the consistency of innovation platform management elements for the medical AI industry.

3. To create and confirm the innovation platform management model for the future development of the medical AI industry.

According to the research results (in Chapter 4), the conclusions are as follows.

1. This study identified 5 aspects, 11 themes and 35 elements for innovation platform management in medical AI industry. Highlighting a multi-faceted approach to foster innovation, emphasizing the importance of data privacy, domain knowledge base development, interdisciplinary talent cultivation, clinical-AI integration, organizational management.

Results of data analysis obtained from in-depth interview to identify the existing problems, opportunities and innovative solutions in the medical AI industry

By in-depth interview the elements of problems, opportunities and innovative solutions in the medical AI industry are obtained. There are three parts of data analysis, namely problems and challenges analysis, opportunities and trends analysis, innovative solutions of innovation platform analysis.

From problems and challenges analysis, six key themes emerged: medical data, algorithm, clinical application, talents, commercialization, ethnics and law. Among all the 19 elements that proposed by experts, the most frequently identified challenges were the lack of data standards and sharing mechanisms and the scarcity of interdisciplinary talents. These issues were recognized by all experts, highlighting the critical need for data standardization and talent development within the medical

AI field. The second high frequency challenges were: without their own core algorithms, most Chinese companies use fine-tuned model on foreign open-source algorithms; Lagging laws and regulations are unable to effectively support the legal and compliant application of innovative products. The third one was element: unclear of business model and monetization model, which was mentioned by 3 experts.

On the ranking list of six themes of problems and challenges, talents challenge was most important and recognized by all experts, clinical application was the second important and recognized by 4 experts. Algorithm and core technologies challenges as well as commercialization problems were regarded as the third importance, which received 3 experts comments respectively.

Opportunities and trends analysis revealed four main aspects: infrastructure, technology innovation, application scenario, policies and regulations, and eight themes, including medical data, algorithm, key core technology, innovative talents, clinical application, commercialization, industry polices, ethnics and law.

Among all the 25 elements of opportunities and trend that proposed by experts, promoting deep integration between clinical demands and AI technology and providing industrial policy support to connect the entire industry chain were seen as the most promising opportunities. There were four elements ranked in the second important place and mentioned by 3 experts respectively: establish medical data standards and norms; improve algorithm accuracy; cultivate interdisciplinary talents in medicine and AI; policies and regulations should be predictable and sustainable.

In infrastructure aspect there were 3 elements under medical data theme and 2 elements under algorithm. In technology innovation aspect, there were 5 elements under key core technology theme and under innovative talents theme respectively. In application scenario aspect, there were 1 element under clinical application theme and 4 elements under commercialization theme. In policies and regulations aspect, there were 2 elements under industry policies theme and 3 elements under ethnics and law theme.

The elements in technology innovation aspect and the elements under commercialization theme were diversified with low frequency. All of them were

recognized by 1 or 2 experts respectively only. It seemed that experts hoped to find more solutions but had not reached consensus yet.

Innovative solutions of innovation platform analysis focused on platform organization aspect which includes two themes: role positioning and development trends and suggestions. There were 2 elements under role positioning and 6 elements under development trends and suggestions. The development trends and suggestions theme had five elements with low frequency.

Based on the elements identified from both literature review and in-depth interview the researcher made a summary and got 5 aspects, 10 themes and 41 elements for innovation platform management in medical AI industry.

Results of data analysis obtained from experts survey, to evaluate the consistency of management elements of innovation platform in medical AI industry.

Among all the elements that evaluated by experts, 10 items were considered highly compliant, including protect medical data privacy, develop domain knowledge base, cultivate interdisciplinary talents, meet demands of segmented scenes, integration between clinical demands and AI technology, business loop and pilot projects, priority to products that have passed project review and approval for entering clinical application, develop its own underlying algorithms and large model for industry use, provide clinical resources and application scenario, commercialization and promotion supports.

There were 8 items with a median value of 3.0 and below or an inter-quartile range of 2 and above. It indicated these elements were general or less important, or the consistency of expert evaluations of the importance of them were general or low. These 8 items should be removed and there were 33 items left.

Experts' feedback also suggested augmenting the infrastructure aspect with computing power considerations, recommending the introduction of cloud service providers or public computing power supplies to reduce R&D costs and enhance the platforms innovation capabilities.

2. The proposed management model presents a comprehensive framework including five aspects: infrastructure management, technology innovation management, application scenarios management, policy and regulation management, and platform organization management. All the

elements together constitute an efficient, flexible, and sustainable management framework, which helps to promote the rapid development and application of medical AI technology.

Results of creating and confirming management model of innovation platform in medical AI industry.

The management model had been confirmed by all five experts, and the median value of all projects were 3.50 and above, and the quartile distance were 1.50 and below. Based on these findings, a management model was created and confirmed, consisting of 5 management aspects, 11 management themes and 35 elements. This model encompasses infrastructure management, technology innovation management, application scenario management, policy and regulation management, and platform organization management. These elements together constitute an efficient, flexible, and sustainable management framework, which helps to promote the rapid development and application of medical AI technology.

Discussion

1. A call for the collaboration of various stakeholders in medical AI industry development

The study findings indicate that there are many challenges seriously constrain the application of medical AI technology and development of medical AI industry. To overcome these challenges and capitalize on the opportunities, the research identified a batch of diversified solutions. The evaluation of innovation platform management elements revealed a consensus among experts on the importance of data privacy, domain knowledge base development, interdisciplinary talent cultivation, close integration between clinical needs and AI technology, the organization management of the innovation platform. This indicates that the development of emerging industries is influenced by multiple factors which involve stakeholders across multiple sectors-the technology research institute, medical AI companies, hospitals, policy-makers, and the investors. It highlights the importance of coordinated development among various stakeholders in industrial development (Bombaywala & Riandita, 2015, Tripathi, Hietala, Xu & Liyanage, 2024, Li, Yang, Lei, Lim & Hou, 2022). There is an urgent need for collaboration between stakeholders in order to integrate external knowledge sources in the innovation process

(Bombaywala & Riandita, 2015), form multi-actor network and dynamic behavioral relationship (Tsujimotoi, Kajikawa, Tomita & Matsumoto, 2018), with each actor playing a distinct role (Tripathi et al., 2024).

In such network and relationship, the factors are mutually influenced and restricted. For example, talent is considered the biggest challenge in the current medical AI industry, while talent and other factors such as medical data, clinical applications, and platform organizational management are considered the most operable in solutions. This fully reveals the importance of integration between stakeholders in order to cultivate interdisciplinary talents both in quantity and quality, develop data standardization and security policies that are clear and enforceable, but also well matched to the needs of the medical practise and aligned with products and technologies currently being developed in the market.

2. How the innovation platform works to facilitate the development of medical AI industry.

The Innovation platform acts as connector, enabler, and toolbox that holds the entire medical AI ecosystem together. It provides a common ground for stakeholders to collaborate, share knowledge, and access resources needed to drive innovation forward (Gawer & Cusumano, 2014, Tsujimotoi et al., 2018). By doing so, the platform not only accelerate the development of new AI technologies but also ensure that these technologies are aligned with the evolving needs of the medical industry.

The key to the success of an innovation platform management lies in its ability to define its unique value proposition and outline a clear road map for achieving its goals. This involves identifying the platform's core competencies and leveraging these strengths to create a competitive advantage. For instance, the innovation platform may focus on developing advanced AI algorithms, or specialize in clinical validation or market access. By clearly defining its role within the medical AI ecosystem, the innovation platform can attract the right stakeholders and resources to support their growth.

Another critical aspect of innovation platform management is creating an overarching structure that facilitates collaboration between various stakeholders. This includes establishing governance mechanisms, setting up communication channels, and creating incentives for collaboration. By fostering a collaborative environment,

the innovation platform can break down silos and enable stakeholders to work together towards a common goal.

This study adopts three theories: platform empowerment theory, industrial symbiosis theory and synergy theory as the underlying theories to explore the mechanism and role of open innovation systems from different perspectives. It explains how open innovation systems function: facilitation of the innovation process for individual companies and creation of an innovation community (Van der Borgh, Cloodt & Romme, 2012). For example, the core concept of platform empowerment theory is value co-creation, and the platform empowers all stakeholders in the platform network through elements such as structure, organization, technology and scenarios. The core concept of platform industry symbiosis is mutual benefit and coexistence, which promotes the evolution and development of the industry symbiosis network through internal and external influencing factors, in order to obtain the best symbiotic energy. The core of synergy theory is efficient collaboration. The platform ecosystem enables its sub-units to collaborate with each other through key influencing factors such as organization, structure, technology, market, etc., making the overall value greater than the sum of individual values.

Recommendations

1. It is necessary to evaluate the effectiveness of the model, collect feedback, and make improvements in practical application.

while the management model and guidelines have been created in this study for the innovation platform in the medical AI industry, it is necessary to evaluate the effectiveness, collect feedback, and make improvements in practical application. As a key priority, it is recommended to concentrate on the development of metrics and indicators to accurately evaluate the effectiveness, efficiency, and sustainability of the management model in fulfilling the objectives of the innovation platform. Regular reassessment of this model is crucial to incorporate feedback, flexibly adapt to evolving technologies, environmental changes, and organizational dynamics, and refine strategies for attaining optimal performance. Furthermore, it is important to examine the significance of common goals, communications, and coordination mechanisms within the innovation platform and stakeholder networks, as they play a pivotal role in enhancing the overall success of the innovation platform.

2. A continual reassessment of the model should be taken to identify areas of vulnerability, adapting to changing policies and adhering to regulations.

As the medical field is highly regulated, tightening or loosening of policies can have significant impacts on the development of medical AI industry. It is crucial to identify and monitor scenarios where the management model may fail. Scenarios such as national monopolistic takeovers or unavoidable compliance issues can threaten the viability of the model. It is important to find out the influence boundaries and the constraint elements. To address these challenges and adapt to changes, proactive measures could be taken. This may include a continual reassessment of the model to identify areas of vulnerability, followed by swift yet strategic adaptations that align with changing policies and ensure adherence to regulations.

Future Research

1. Customized management models are to be studied for diverse specific platforms to effectively foster industry growth and ensure that each platform realizes its full potential for development.

As the medical AI industry evolves, innovation platforms are becoming increasingly diverse. It becomes evident that each one demands a unique approach. From nationally funded innovation platforms to corporate-backed ones, from those focused on technological research to those oriented towards industrial applications, and from physical entities to virtual spaces, each innovation platform harbors distinct characteristics. Therefore, a profound understanding of these differences is imperative in order to develop customized and targeted management models that cater specifically to their needs. The future research could focus on the customized management models for diverse platforms to effectively foster industry growth and ensure that each platform realizes its full potential for development.

2. The future research could invite a broader pool of experts from other provinces of China as well as international specialists to participate.

When considering the limitations of this study, it is important to note that due to constraints in data availability and research methods, our research was primarily based on expert interviews and process confirmations. Given that the majority of experts in this study hailed from Zhejiang Province in China, we recommend that

future endeavors invite a broader pool of experts from other provinces within China as well as international specialists to participate, thus broadening the scope and depth of our knowledge by comparing the model data with other countries.

References

Agarwal, R., Bjarnadottir, M., Rhue, L., Dugas, M., Crowley, K., Clark, J., & Gao, G. (2023). Addressing algorithmic bias and the perpetuation of health inequities: An AI bias aware framework. *Health Policy and Technology*, 12(1), 100702. https://doi.org/10.1016/j.hlpt.2022.100702

Ahmad, M. A., Eckert, C., Allen, C., Kumar, V., Hu, J., & Teredesai, A. (2021). Fairness in Healthcare AI. *In 2021 IEEE 9th International Conference on Healthcare Informatics (ICHI)* (pp. 554-555). Victoria, BC, Canada. https://doi.org/10.1109/ICHI52183.2021.00104

Auld, G., Casovan, A., Clarke, A., & Faveri, B. (2022). Governing AI through ethical standards: Learning from the experiences of other private governance initiatives. *Journal of European Public Policy*, 29(11), 1822-1844. https://doi.org/10.1080/13501763.2022.2099449

Bao, J. (2019). Synergy Theory: The Science of Collaboration - Interview with Professor Haken, Founder of Synergy Theory. *Tsinghua Management Review*, (11), 6-19.

Bombaywala, M., & Riandita, A. (2015). Stakeholders' collaboration on innovation in the food industry. *Procedia - Social and Behavioral Sciences*, 169, 395-399. https://doi.org/10.1016/j.sbspro.2015.01.325

Braun, T., & Harasimiuk, D. E. (2023*). AI deployment in medical devices—ethical and regulatory reflections, beyond data protection and bias—EU perspective. In 2023 IEEE Conference on Computational Intelligence in Bioinformatics and Computational Biology* (CIBCB) (pp. 1-6). Eindhoven, Netherlands. https://doi.org/10.1109/CIBCB56990.2023.10264892

Cai, J., & Tian, W. (2022). The impact of industry-university-research cooperation of scientific and technological innovation platform on the dual innovation performance of enterprises: A study based on the dynamic evaluation data of Guangdong Engineering Technology Center. *Science and Technology Management Research*, No. 11, 102-107.

Cai, Y. Z., & Chen, N. (2019). Artistic intelligence and high-quality growth & employment in the era of new technological revolution. *The Journal of Quantitative & Technical Economics*, 36(5), 3-22.

Cao, Y., & Kong, X. (2020). Black Sea strategy: A new strategic model in the industrial Internet Age. *Tsinghua Management Review,* (11), 85-92.

Čartolovni, A., Tomičić, A., & Lazić Mosler, E. (2022). Ethical, legal, and social considerations of AI-based medical decision-support tools: A scoping review. *International Journal of Medical Informatics*, 161, 104738. https://doi.org/10.1016/j.ijmedinf.2022.104738

Chauhan, S., & Keprate, A. (2022). Standards, ethics, legal implications & challenges of artificial intelligence. *In 2022 IEEE International Conference on Industrial Engineering and Engineering Management* (IEEM) (pp. 1048-1052). Kuala Lumpur, Malaysia. https://doi.org/10.1109/IEEM55944.2022.9989614

Chen, C. (2021). Analysis on value creation mechanism of retail enterprise platform business model from the perspective of value network. *Business Economics Research,* (5), 132-135.

Chen, F., & Xia, X. (2007). Analysis of "Industrial Symbiosis." *Industrial Technology and Economy,* 26(1), 54-56.

Chen, J. (2021). Research on the integrated innovation path of artificial intelligence and the real economy. *People's Forum*, (01), 29-31.

Chen, J. (2021). Research on value co-creation mechanism from the perspective of platform empowerment—Empirical analysis based on Taobao platform. *Journal of North China University of Science and Technology* (Social Sciences Edition), (05), 36-43.

Chen, J. (2021). Research on the mechanism of value co-creation from the perspective of platform empowerment: An empirical analysis based on Taobao platform. *Journal of North China University of Science and Technology* (Social Science Edition), 21(5), 36-42.

Chen, X. (2022). Research on the development status and countermeasures of scientific and technological innovation platform: Take Zhuzhou City, Hunan Province as an example. *Technology and Market,* (11), 41-43.

Chen, X., Jiang, Y., Xiong, Y., & Zhang, L. (2023). Identification and application of key core technology bottleneck issues: Taking AI chips as an example. *China Science and Technology Forum,* (09), 17-27. https://doi.org/10.13580/j.cnki.fstc.2023.09.017

Chen, Z. (2013). Connotative characteristics and development thinking of scientific and technological innovation platform. *Scientific and Technological Management Research,* 33(17), 34-37.

Clusmann, J., Kolbinger, F. R., Muti, H. S., et al. (2023). The future landscape of large language models in medicine. *Commun Med,* 3, 141. https://doi.org/10.1038/s43856-023-00370-1

Costa, I., Massard, G., & Agarwal, A. (2010). Waste management policies for industrial symbiosis development: Case studies in European countries. *Journal of Cleaner Production,* 18(8), 815-822. https://doi.org/10.1016/j.jclepro.2009.12.019

Dai, J., & Gu, X. (2020). Where will artificial intelligence bring education? Interpretation of WIPO's "2019 Technology Trends: Artificial Intelligence" Report. *China's Audiovisual Education,* (10), 24-31+66.

Dilsizian, S. E., & Siegel, E. L. (2014). Artificial intelligence in medicine and cardiac imaging: Harnessing big data and advanced computing to provide personalized medical diagnosis and treatment. *Curr Cardiol Rep*, 16, 441. https://doi.org/10.1007/s11886-013-0441-8

Duan, Y., Edwards, J. S., & Dwivedi, Y. K. (2019). Artificial intelligence for decision making in the era of big data—Evolution, challenges, and research agenda. *International Journal of Information Management*, 48, 63–71.

Du, Y. (2018). Artificial intelligence + healthcare: Technology is not the core issue of AI healthcare, and whether it can be commercialized becomes the key. *The Era of Big Data*, (06), 13-17.

El Kafhali, S., Alzubaidi, L., Al-Sabaawi, A., Bai, J., Dukhan, A., Alkenani, A. H., AlAsadi, A., Alwzwazy, H. A., Manoufali, M., Fadhel, M. A., Albahri, A. S., Moreira, C., Ouyang, C., Zhang, J., Santamaría, J., Salhi, A., Hollman, F., Gupta, A., Duan, Y., Rabczuk, T., Abbosh, A., & Gu, Y. (2023). *Towards risk-free trustworthy artificial intelligence: Significance and requirements.* Int. J. Intell. Syst., 2023, Article ID 4459198, 41 pages. https://doi.org/10.1155/2023/4459198

Fang X., Li X. & Wei S. (2024), Scenario driven Government Digital Transformation: How Digital Technology Responds to Complex Governance Needs - Taking Nantong City, Jiangsu Province as an Example. *Electronic government*:1-14.

Fan, R. (2021). Empowering platform technology, public games, and complex adaptive governance. *Chinese Social Sciences*, (12), 131-152+202.

Fan, S., & Tan, Z. (2019). Challenges and changes in the construction of "new medical science" in the context of artificial intelligence. *China University Science and Technology,* (07), 56-59. https://doi.org/10.16209/j.cnki.cust.2019.07.14

Fan, Z., & An, H. (2022). Research and analysis on artificial intelligence application scenarios. *Robotics Industry,* (03), 86-90. https://doi.org/10.19609/j.cnki.cn10-1324/tp.2022.03.017

Firouzi, F., Farahani, B., Barzegari, M., & Daneshmand, M. (2022). AI-Driven Data Monetization: The Other Face of Data in IoT-Based Smart and Connected Health. *IEEE Internet of Things Journal*, 9(8), 5581-5599. https://doi.org/10.1109/JIOT.2020.3027971

Gamito, M. C. (2023). The influence of China in AI governance through standardisation. *Telecommunications Policy*, 47(10). https://doi.org/10.1016/j.telpol.2023.102673

Gao, G., Huang, W., Cao, S., Chen, C., & Zheng, D. (2021). Research progress in the application of artificial intelligence in medicine. *Chinese Journal of Medical Physics*, 8(08), 1044-1047.

Gawer, A., & Cusumano, M. A. (2014). Industry Platforms and Ecosystem Innovation. *Journal of Product Innovation Management,* 31, 417-433. https://doi.org/10.1111/jpim.12105

Guan, T., Xue, L., & Zhao, J. (2019). Governance Innovation Empowered by Technology: Based on Practical Cases in the Environmental Field in China. *Chinese Administration*, 57(04), 58-65. https://doi.org/10.19735/j.issn.1006-0863.2019.04.07

Hallowell, N., Badger, S., McKay, F., Kerasidou, A., & Nellåker, C. (2023). Democratising or disrupting diagnosis? Ethical issues raised by the use of AI tools for rare disease diagnosis. *SSM - Qualitative Research in Health*, Volume 3, 100240. https://doi.org/10.1016/j.ssmqr.2023.100240

Han, J. H., & Lee, J. Y. (2021). Digital Healthcare Industry and Technology Trends. In 2021 IEEE International Conference on Big Data and Smart Computing (BigComp) (pp. 375-377). *Jeju Island, Korea (South).* https://doi.org/10.1109/BigComp51126.2021.00083

Han, F., Yang, D., Li, Y., & Shi, F. (2019). Research Progress of the Evolution of Industrial Symbiosis Network. *China Environmental Management*, 6, P113-P120.

Hao, J. (2021). Baidu Feizhu's three-year report: From open source framework to AI mass production platform. *IT Times*

HE, J., & GUO, X. (2022). Frontiers and Findings of the Studies on Opening Strategy of Innovation Platforms. *QILU JOURNAL*, 2, 119-131.

Haken, H. (1997). Visions of synergetics. *Journal of the Franklin Institute*, 334(5–6), 759-792. https://doi.org/10.1016/S0016-0032(97)00032-X

He, X., & Hu, C. (2023). Application and problem exploration of big data in the medical field. *Digital Technology and Application*, 41(1), 52-54.

Hicks, W. D., Schmeidler, E., & Kirchner, C. (2004). Investigating question meaning and context through in-depth interviews. *Quality & Quantity*, 38, 367–379. https://doi.org/10.1023/B:QUQU.0000043133.61603.e9

Holzinger, A., Keiblinger, K., Holub, P., Zatloukal, K., & Müller, H. (2023). AI for life: Trends in artificial intelligence for biotechnology. *New Biotechnology*, 74, 16-24. https://doi.org/10.1016/j.nbt.2023.02.001

Huo, W., Yuan, X., Li, X., Luo, W., Xie, J., & Shi, B. (2023). Increasing acceptance of medical AI: The role of medical staff participation in AI development. *International Journal of Medical Informatics*, 175, 105073. https://doi.org/10.1016/j.ijmedinf.2023.105073

iResearch. (2021). After Dawn, the early sun shines in the forest: Research Report on China's Artificial Intelligence+Medical and Life Sciences Industry. *In Research Report on iResearch Consulting Series* (Issue 11, 2021, pp. 159-240).

Jia, Y., Qi, Y., & Sun, M. (2023). Research on the Modernization of Policies and Governance Systems for the New Generation of Artificial Intelligence Industry. *China Science and Technology Forum*, 12, 51-60.

Jiang, F., Xiong, B., & Zhang, C. (2020). How China's AI Achieves Strategic Breakthroughs: Based on the comparison and interpretation of four AI development reports from China and the United States. *Modern Distance Education Research,* 1, 3-11.

Jin, Y., & Feng, J. (2021). Analysis of opportunities and challenges for the development of medical imaging AI under the framework of ROCCIPI. *China's Medical Equipment,* 11, 1-3+19.

Ji, P., Zhu, D., Xiao, P., Xu, W., & Guo, R. (2022). Risk assessment and response in medical artificial intelligence research. *Medicine and Philosophy*, 8, 7-9+28.

Kondylakis, H., et al. (2017). iManageCancer: Developing a Platform for Empowering Patients and Strengthening Self-Management in Cancer Diseases. *In 2017 IEEE 30th International Symposium on Computer-Based Medical Systems (CBMS)* (pp. 755-760). https://doi.org/10.1109/CBMS.2017.62

Kong, X., Tang, X., & Wang, Z. (2021). Research review on the interpretability of artificial intelligence decision-making. *System Engineering Theory and Practice*, 2, 524-536.

Liao, Z., Tian, X., & Liu, Y. (2021). The Enlightenment of Japan's Medical Big Data Law on the Development and Application of Health and Medical Big Data in China. *China Digital Medicine*, 7, 88-93.

Li, C., Yang, K., Lei, Z., Lim, M. K., & Hou, Y. (2022). Exploring stakeholder collaboration based on the sustainability factors affecting the sharing economy. *Sustainable Production and Consumption,* 30, 218-232. https://doi.org/10.1016/j.spc.2021.12.009

Li, J., & Zhang, F. (2020). Opportunities and Challenges for Artificial Intelligence to Improve Medical Efficiency in China*. Jiangnan Forum*, 10, 30-32.

Liu, H., Liu, M., Tang, S., Liu, J., Liao, Z., Xu, Y., & Zhou, Y. (2023). Research on the Application and Development of New Infrastructure for Medical Artificial Intelligence. *China Digital Medicine*, 8, 1-7.

Liu, L., & Wang, D. (2020). Application and existing problems of artificial intelligence in the medical field. *Soft Science of Health*, 34(10), 23-27.

Liu, L., Zhang, T., & Yang, M. (2018). Using a multi-level model to calculate and correct the Cronbach alpha coefficient. *China Health Statistics*, 6, 838-842.

Liu, Z., Xu, N., & Tao, C. (2018). Application and Prospects of Artificial Intelligence in the Medical Field. *Network Security Technology and Applications*, 8, 98-99.

Li, X. (2020). The current practical needs and key directions for the construction of new artificial intelligence infrastructure in China. *Technology in China*, 9, 1-3.

Li, Y., Feng, X., & Wang, Z. (2018). Development Trends and Application Prospects of Artificial Intelligence in the Medical Industry. *Artificial Intelligence*, 4, 12-21. https://doi.org/10.16453/j.cnki.issn2096-5036.2018.04.003

Li, Y., Zhang, J., Gu, Y., Zhu, Y., He, Q., & Li, L. (2019). Comparative study on national artificial intelligence strategic development plans in the field of medicine and health. *China Engineering Science*, 21(6), 106-113.

Li, Z., Wang, H., Li, Y., & Chen, H. (2021). A Brief Talk on the Current Situation and Development Trend of Artificial Intelligence Medical Robot. *Modern Instrument and Medical,* 27(5), 93-96. https://doi.org/10.11876/mimt202105026

Lucas, S. R. (2014). Beyond the existence proof: Ontological conditions, epistemological implications, and in-depth interview research. *Qualitative Quantity,* 48, 387–408. https://doi.org/10.1007/s11135-012-9775-3

Lu, J. (2020). Opportunities and challenges of artificial intelligence under new infrastructure. *Robotics Industry*, 28-32. https://doi.org/10.19609/j.cnki.cn10-1324/tp.2020.03.005

Luo, F. (2021). The commercialization dilemma of artificial intelligence healthcare. *Zhangjiang Technology Review*, (5), 40.

Lu, X., Wang, H., Zheng, Q., Li, R., & Huang, Y. (2021). Policy Text Analysis of Medical Artificial Intelligence in China from the Perspective of Policy Tools. *Chinese Journal of Health Information Management,* (6), 802-808.

Ma, S., Yu, G., & Cui, W. (2018). Thinking and Suggestions on the Sharing and Application of Health Care Big Data in the Regional Health Informatization Environment. *China Digital Medicine*, 13(4), 11-13, 25.

Mao, Y. (2020). Exploration of the "Principal Responsibility System" Talent Training Model for Medical Artificial Intelligence. *Modern Commerce and Industry,* (15), 70. https://doi.org/10.19311/j.cnki.1672-3198.2020.15.032.

Mao, Y., Cao, J., & Fang, Y. (2021). Research on Collaborative Network Structure of *Technical Innovation in New R&D Institutions*. (3), 76-82.

Meng, X., Zhang, Y., & Chen, Z. (2023). Application and Development of Artificial Intelligence in the Field of Traditional Chinese Medicine. *Jilin Traditional Chinese Medicine,* 43(5), 618-620.

Neves, J., Hsieh, C., Nobre, I. B., Sousa, S. C., Ouyang, C., Maciel, A., Duchowski, A., Jorge, J., & Moreira, C. (2024). Shedding light on AI in radiology: A systematic review and taxonomy of eye gaze-driven interpretability in deep learning. *European Journal of Radiology,* 172, 111341. https://doi.org/10.1016/j.ejrad.2024.111341

Niu, L., Xie, Z., Cheng, H., Lv, Q., & Liu, Z. (2020). The Application and Development of Artificial Intelligence in the Medical Field in the UK and Its Enlightenment. *Journal of Medical Informatics*, (1), 2-6.

Orange, R. M. (2003). Individualism, family values, and the professional middle class: In-depth interviews with advanced law and MBA students. *The Sociological Quarterly*, 44(3), 451-480. https://doi.org/10.1111/j.1533-8525.2003.tb00541.x

Pandurangan, P., Rakshi, A. D., Sundar, M. S. A., Samrat, A. V., Meenambiga, S. S., Vedanarayanan, V., Meena, R., Namasivayam, S. K. R., & Moovendhan, M. (2024). Integrating cutting-edge technologies: AI, IoT, blockchain and nanotechnology for enhanced diagnosis and treatment of colorectal cancer - A review. *Journal of Drug Delivery Science and Technology*, 91, 105197. https://doi.org/10.1016/j.jddst.2023.105197

Pang, F. (2022). The AI Chip Race. *IEEE Intelligent Systems,* 37(2), 111-112. https://doi.org/10.1109/MIS.2022.3165668

Park, S. -G., Kim, A., Yoon, T., Kamyod, C., & Kim, C. G. (2023). A study of generative large language model for healthcare. In 2023 7th International Conference on Information Technology (InCIT) (pp. 397-400). *Chiang Rai, Thailand.* https://doi.org/10.1109/InCIT60207.2023.10412989

Pei, P., & Yu, B. (2023). Literature Review of Research on healthcare data governance in the face of ecosystem construction. *In 2023 8th International Conference on Intelligent Informatics and Biomedical Sciences (ICIIBMS)* (pp. 509-511). Okinawa, Japan. https://doi.org/10.1109/ICIIBMS60103.2023.10347789

Porto-Gomez, I., Zabala-Iturriagagoitia, J. M., & Leydesdorff, L. (2019). Innovation systems in México: A matter of missing synergies. *Technological Forecasting and Social Change,* 148, 119721. https://doi.org/10.1016/j.techfore.2019.119721

Qian, T. (2023, May 16). How does the AI big model empower medical imaging? Exploring potential application scenarios for medical enterprises. *First Financial Daily*, A09. 10.28207/n.cnki.ndycj.2023.002069

Qiu, J., et al. (2023). Large AI Models in Health Informatics: Applications, Challenges, and the Future. *IEEE Journal of Biomedical and Health Informatics, 27*(12), 6074-6087. https://doi.org/10.1109/JBHI.2023.3316750

Ramaswamy, V., & Ozcan, K. (2016). Brand value co-creation in a digitalized world: An integrative framework and research implications. *International Journal of Research in Marketing,* 33(1), 93-106. https://doi.org/10.1016/j.ijresmar.2015.07.001

Rasiah, R. (2019). Building networks to harness innovation synergies: Towards an open systems approach to sustainable development. *Journal of Open Innovation: Technology, Market, and Complexity,* 5(3), 70. https://doi.org/10.3390/joitmc5030070

Reddy, S., Allan, S., Coghlan, S., & Cooper, P. (2020). A governance model for the application of AI in health care. *Journal of the American Medical Informatics Association,* 27(3), 491–497. https://doi.org/10.1093/jamia/ocz192

Shen, X., Li, M., Nan, J., Zhang, W., Sun, Y., Cha, M., & Gao, D. (2023). Analysis of the development trend and problems of medical artificial intelligence. *Science and Technology Management Research,* 07, 193-198.

Sheng, Y., Liu, Y., & Shi, Y. (2021). Analysis of the types and characteristics of China's scientific and technological innovation platforms based on the two-dimensional quadrant model. *Innovative Science and Technology*, 21(4), 9-18.

Sheng Ya, Liu Yue&Shi Yu (2022). Research on the Value Creation Path of Scientific and Technological Innovation Platform Based on Multi cases. *TechnologyManagement Research* (16), 132-145

Shen, Z., Chen, H., Li, W., et al. (2021). The application and challenges of artificial intelligence and big data in clinical engineering. *Modern Instruments and Medicine,* 27(5), 75-78. https://doi.org/10.11876/mimt202105022

Shi, Z., & Liu, Z. (2021). Pay attention to the standardization of medical image artificial intelligence database. *Concord Medical Journal*, 05, 599-601.

Sun, Y., Gao, J., & Wu, J. (2021). Clinical medical artificial intelligence: Typical applications and challenges. *Chinese Journal of Stroke,* 16(7), 643-648.

Si, R., Li, W. X., & Su, J. W. (2021). The application of artificial intelligence in the medical field. *China Medicine*, 16(6), 957-960.

Taddeo, R., Simboli, A., Morgante, A., & Erkman, S. (2017). The development of industrial symbiosis in existing contexts: Experiences from three Italian clusters. *Ecological Economics*, 139, 55-67. https://doi.org/10.1016/j.ecolecon.2017.04.006

Taddeo, R., Simboli, A., Ioppolo, G., & Morgante, A. (2017). Industrial symbiosis, networking and innovation: The potential role of innovation poles. *Sustainability,* 9(2), 169. https://doi.org/10.3390/su9020169

Taimoor, N., & Rehman, S. (2022). Reliable and Resilient AI and IoT-Based Personalised Healthcare Services: A Survey. *IEEE Access,* 10, 535-563. https://doi.org/10.1109/ACCESS.2021.3137364

Tan, Z., Han, X., & Ding, T. (2020). The development dilemma and countermeasures of medical artificial intelligence in China. *Health Economics Research*, 37(6), 13-15.

Tekic, Z., & Füller, J. (2023). Managing innovation in the era of AI. *Technology in Society,* 73, 102254. https://doi.org/10.1016/j.techsoc.2023.102254

Tripathi, N., Hietala, H., Xu, Y., & Liyanage, R. (2024). Stakeholders collaborations, challenges and emerging concepts in digital twin ecosystems. *Information and Software Technology,* 169, 107424. https://doi.org/10.1016/j.infsof.2024.107424

Tsujimoto, M., Kajikawa, Y., Tomita, J., & Matsumoto, Y. (2018). A review of the ecosystem concept—towards coherent ecosystem design. *Technological Forecasting and Social Change,* 136, 49-58. https://doi.org/10.1016/j.techfore.2017.06.032

Verganti, R., Vendraminelli, L., & Iansiti, M. (2020). Innovation and design in the age of artificial intelligence. *Journal of Product Innovation Management*, 37, 212-227. https://doi.org/10.1111/jpim.12523

Van der Borgh, M., Cloodt, M., & Romme, A. G. L. (2012). Value creation by knowledge-based ecosystems: Evidence from a field study. *R&D Management*, 42, 150-169. https://doi.org/10.1111/j.1467-9310.2011.00673.x

Wang, C., & Chen, S. (2018). Research on the development trend of open source platform in artificial intelligence. *Information and Communications* Technology and Policy, 8.

Wang Y, Fan Z & Sun H. (2021). Empowerment Theory Evolution under the Background of Platform Economy: Literature Review and Prospects Era. *Economy and Trade* (12), 5-9. doi: 10.19463/j.cnki. sdjm. 2021.12.01

Wang, H., Chen, Y., & Zhao, K. (2020). The current situation of the development of China's artificial intelligence medical industry and international experience. *Health Economics Research*, (9), 9-11+15. https://doi.org/10.14055/j.cnki.33-1056/f.2020.09.002

Wang, H., Chen, M., Shang, H., & Wang, T. (2023). Research on the development of new generation artificial intelligence open innovation platforms in Guangdong Province. *Guangdong Science and Technology*, (2), 12-16.

Wang, J., Cai, N., & Sheng, Y. (2018). Cross order entrepreneurship of focal firms, dual platform architecture and industrial cluster ecosystem upgrading - A case study of Jiangsu Yixing Environmental Hospital. *China Industrial Economy*, (2), 157-175. https://doi.org/10.19581/j.cnki.ciejournal.20180207.001

Wang, W., Deutz, P., & Chen, Y. (2017). Building institutional capacity for industrial symbiosis development: A case study of an industrial symbiosis coordination network in China. *Journal of Cleaner Production*, 142, 1571-1582. https://doi.org/10.1016/j.jclepro.2016.11.146

Wang, T. (2019). Literature Review on Synergistic Effects Theory. *Economic Research Guide,* 31, 11-24.

Wang, X., & Guo, J. (2021). Research and Impact of Artificial Intelligence in the Field of Medical Devices. *China Medical Device Information,* 27(11), 9-10+170. https://doi.org/10.15971/j.cnki.cmdi.2021.11.004

Wang, Y., Lv, L., Zhang, B., Zhao, Y., & Qian, L. (2021). The research and development trend of AI chip patent technology. *Scientific Observation,* (2), 57-71. https://doi.org/10.15978/j.cnki.1673-5668.202102004

Wang, X., & Hu, H. (2021). Exploration and Reflection on the Reform of Medical Talent Training in the Context of AI Healthcare. *Science and Education Literature Collection,* (Later Issue), 36, 123-125. https://doi.org/10.16871/j.cnki.kjwhc.2021.12.040

Wang, Y., Fan, Z., & Sun, H. (2021). Empowerment Theory Evolution under the Background of Platform Economy: Literature Review and Prospects. *Era Economy and Trade*, 12, 5-9. https://doi.org/10.19463/j.cnki.sdjm.2021.12.01

Winkler, J., & Moser, R. (2016). Biases in future-oriented Delphi studies: A cognitive perspective. *Technological Forecasting and Social Change*, 105, 63-76. https://doi.org/10.1016/j.techfore.2016.01.021

Winter, J. S. (2019). AI in healthcare: Data governance challenges. *Journal of Hospital Management and Health Policy,* 5. http://dx.doi.org/10.21037/jhmhp-2020-ai-05

Wright, R., & Stein, M. (2005). Snowball Sampling. *In K. Kempf-Leonard* (Ed.), Encyclopedia of Social Measurement (pp. 495-500). Elsevier. doi:10.1016/B0-12-369398-5/00087-6

Wu, A., Song, D., & Liu, Y. (2022). Platform synergy and innovation speed of SMEs: The roles of organizational design and regional environment. *Journal of Business Research,* 149, 38-53. https://doi.org/10.1016/j.jbusres.2022.05.016

Wu, X. (2021). Governance of medical artificial intelligence tort liability: Development status and strategic suggestions. *People of the Times*, 27, 100-102.

Wu, Y. (2019). The Application and Reflection of Deep Interview Method in Field Investigation of White Deer Plain. *New West,* 15, 31-34.

Xie, J. (2021). Analysis and enlightenment of the development of medical AI in the United States. *Journal of Medical Informatics,* 2, 2-8.

Xu, X., & Wang, F. (2015). Research progress in the theory and practice of industrial symbiosis from the perspective of environmental ecology. *Environmental Science and Management,* 12, 1-3.

Yang, S., & Sun, F. (2005). In-depth interviews as a means of exploration. *Sociological Research,* 5, 53-68+244. https://doi.org/10.19934/j.cnki.shxyj.2005.05.003

Yao, Y. (2022). Multidimensional Interpretation and Selection: Exploring the Path of Intellectual Property Protection in Artificial Intelligence Algorithms. *Technology and Law (Chinese and English),* 1, 53-61. https://doi.org/10.19685/j.cnki.cn11-2922/n.2022.01.007

Ye, X., Ma, S., Wang, Y., et al. (2023). Research on the Evolution of China's Intelligent Medical Industry from a Scenario-driven Perspective. Science and Technology

Progress and Countermeasures. Retrieved from http://kns.cnki.net/kcms/detail/42.1224.G3.20230710.2120.019.html

Ye, Z., Shen, Y., Jiang, X., & Yuan, H. (2024). Key research on ethical governance in the field of medical artificial intelligence. *Chinese Medical Ethics,* 1, 39-44.

Yin X., Su Y., Chen J. & Chen T. (2022). Scenario Driven Innovation: Connotative Characteristics, Theoretical Logic, and Practical Approaches. *Technological Progress and Countermeasures* (15), 1-10

Yin, X., Lu, R., & Chen, J. (2023). Research on the Mechanism of Dynamic Capability of Industry Digitization Driven by Scenarios Innovation and Entrepreneurship. *Innovation and Entrepreneurship Management,* 1, 142-159.

Yuan, J., Zhao, L., & Tian, D. (2020). The application and thinking of the new generation of artificial intelligence in the medical and health field. *China Journal of Health Information Management*, 6, 780-785.

Yuan, T., Xue, H., Yang, J., Zhang, Y., Xiong, Y., & Ruan, M. (2022). The development status of artificial intelligence medical applications at home and abroad from the perspective of strategic planning and scientific and technological layout. *Life Science,* 8, 974-982. https://doi.org/10.13376/j.cbls/2022108

Zhang, B., Chen, Y., Mao, Z., & Deng, C. (2021). Legal Issues and Countermeasures for the Application of Artificial Intelligence Medical Data. *Legal Expo*, 8, 18-21.

Zhang, J. (2019). Research on accelerating the construction of international artificial intelligence industry clusters based on the integration of science and innovation in the Yangtze River Delta. *China Development, 6*, 53-63. https://doi.org/10.15885/j.cnki.cn11-4683/z.2019.06.013

Zhang, H., Jin, B., Le, Y., & Xu, M. (2021). Resource/Capability Aggregation and Competitive Advantage Formation Mechanism in Business Incubation: Inspiration from the Y Combinator Case in Silicon Valley. *Shanghai Management Science,* 1, 81-88.

Zhang, L., Feng, F., Xiao, X., Ma, L., & Fu, M. (2013). Industry University Research Symbiosis Network: Concepts, Systems, and Methodological Directions. *Research and Development Management,* 2, 37-44. https://doi.org/10.13581/j.cnki.rdm.2013.02.010

Zhang, L., Qian, Q., Tang, M., Zhou, J., & Wu, S. (2021). Current status of the construction of artificial intelligence medical device standard data sets. *Chinese Journal of Medical Library and Information*, 8, 1-8.

Zhang, S., & Pi, T. (2023). The interpretability dilemma and governance of artificial intelligence applications in the medical field. *Medicine and Philosophy*, 3, 25-29+35.

Zhang, W., & Yu, J. (2008). The Path Selection of Regional Industrial Ecology Based on Industrial Symbiosis Network. *Social Scientist,* 12, 47-50.

Zhang, Y., Zhang, G., Ma, W., & Huang, S. (2022). What new R&D institutions have higher innovation performance: Configuration Analysis Based on TOE Framework. *Research in Science*, 4, 758-768. https://doi.org/10.16192/j.cnki.1003-2053.20210825.001

Zhao, T. (2021). Opportunities and challenges in the application of artificial intelligence in the medical field. *China New Communications,* 12, 158-159.

Zhao, L., & Guo, Y. (2023). Ethical risks of intelligent medical robots: Types, causes, and prevention and control strategies. *Medicine and Philosophy,* 12, 35-39.

Zhao, Y. (2016). Theoretical understanding and basic characteristics of the emergence of new scientific research organizations. *China High Tech Zone,* 1, 146-151.

Zhao, Z., & Zhuang, X. (2023). High quality development of artificial intelligence in China: Current situation, problems, and strategies. *Reform,* 9, 11-20.

Zheng, H., Yang, Y., Ni, J., Qin, Y., Fu, J., & Li, W. (2019). Research progress in clinical applications of artificial intelligence. *Nursing Research,* 3, 454-458.

Zhou, W., & He, Q. (2021). Impact of Entrepreneurial Incubation Platform Empowerment on the Optimization of Resource Allocation: A Case Study Based on Mechanism Design Perspective. *R&D Management,* 33(1), 162-174.

Zhou, W., Chen, L., Deng, W., et al. (2019). The process model of entrepreneurship platform, entrepreneur and consumer value co-creation: Take Xiaomi as an example. *Journal of Management,* 4, 283-294.

Zhou, W., & Fei, Y. (2021). Frontier Research on Medical Artificial Intelligence: Characteristics, Trends, and Regulations. *Medicine and Philosophy,* 19, 38-44.

Zhu, Q., Sun, Y., & Zhou, L. (2019). Research on the Relationship between Platform Empowerment, Value Co-creation, and Enterprise Performance. *Scientific*

Research, 11, 2026-2033+2043. https://doi.org/10.16192/j.cnki.1003-2053.2019.11.012

Zhu, W., & Lv, W. (2022). Development status and prospect of medical AI. *Radiological Practice*, 1, 1-3. https://doi.org/10.13609/j.cnki.1000-0313.2022.01.001

Appendices

Appendix A

List of Specialists and Letters of Specialists Invitation for IOC Verification

Ref. No. MHESI 0643.14/ 510

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

28 March 2024

Subject Invitation for Validate Research Instrument

Dear Dr. Nattachai Plienvijarn

Ms Tang Yuying is a Ph.D. student majoring in Technology and Innovation Management Programme at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry".

The thesis adversity committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement Of this research instrument.

With your expertise, we would like to ask your permission to validate the attached research instrument. Would like to avail ourselves Of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 511

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

28 March 2024

Subject Invitation for Validate Research Instrument

Dear Dr. Nukul Sarawong

Ms Tang Yuying is a Ph.D. student majoring in Technology and Innovation Management Programme at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry".

The thesis adversity committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement Of this research instrument.

With your expertise, we would like to ask your permission to validate the attached research instrument. Would like to avail ourselves Of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 512

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

28 March 2024

Subject Invitation for Validate Research Instrument

Dear Dr. Soisuda Lohmood

Ms Tang Yuying is a Ph.D. student majoring in Technology and Innovation Management Programme at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry".

The thesis adversity committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement Of this research instrument.

With your expertise, we would like to ask your permission to validate the attached research instrument. Would like to avail ourselves Of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Appendix B

Official Letter

1. Invitation for 5 in-depth interview experts
2. Invitation for 17 elements evaluation experts
3. Invitation from 5 model evaluation experts

Invitation for 5 in-depth interview experts

Ref. No. MHESI 0643.14/645

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

27 May 2024

Subject Request permission to collect data by attending an in-depth interview

Dear Mr Chen Xiaoyong, CEO of Hangzhou Ecoo Biotechnology Co., Ltd

Attachment Interview Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation. and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 646

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

27 May 2024

Subject Request permission to collect data by attending an in-depth interview

Dear Mr You Xiangdong, CEO of Zhejiang Venture Capital Co., Ltd.

Attachment Interview Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation. and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ ๖๔๗

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

27 May 2024

Subject Request permission to collect data by attending an in-depth interview

Dear Mr Yao Chang, Research Fellow of School of Computer Science, Zhejiang University

Attachment Interview Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation. and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 643

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

27 May 2024

Subject Request permission to collect data by attending an in-depth interview

Dear Ms Li Qing, Vice Manager of Insigma Technology Co., Ltd.

Attachment Interview Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation. and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 649

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

27 May 2024

Subject Request permission to collect data by attending an in-depth interview

Dear Mr Xiang Peng, Director of Smart Medical Center. Zhejiang University Computing Technology Research Institute

Attachment Interview Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation. and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Invitation for 17 elements evaluation experts

Ref. No. MHESI 0643.14/๕๖๐

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Zhao Wenxiong, Sales Director of NVIDIA Corporation

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 531

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Ms Xie Jin, Marketing Manager of Hangzhou Boea-Wisdom Internet Technology Co., Ltd

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 532

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Xie Changyu, Professor of Zhejiang University

Attachment Validation Sheets

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation. and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 533

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Wu Xiaoge, Partner of Hangzhou Private Equity Fund Management Co., Ltd.

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 534

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Ms Wang Zhenyang, CTO of Zhejiang Qizhen Medical & Health Technology Co., Ltd.

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 535

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Wang Yifang, Vice President of Insigma Goup Co., Ltd.

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 536

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Wang Liming, Product Development Manager of Pfizer (Hangzhou) Innovation Technology Co., Ltd

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 539

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Wang Hu, Section Chief of Zhejiang Provincial Big Data Development Management Bureau

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 534

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Ms Pan Mingxia, Vice General Manager of Zhejiang Traditional Chinese Medicine Health Industry Group Co., Ltd.

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 539

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Pan Jianwei, Chief Physician of The First Affiliated Hospital, Zhejiang University School of Medicine

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 540

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Ms Luo Qiong, Deputy Dean of The Affiliated Obstetrics and Gynecology Hospital of Zhejiang University School of Medicine

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 541

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Liao Jinan, Vice president of Zhejiang Insigma Health Technology Co., Ltd.

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 542

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Liang Dasheng, CEO of Hangzhou Changji Medical Technology Co., Ltd.

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 543

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Kou Haiqing, Operation Director of Zhejiang Insigma Healthcare Technology Co., Ltd.

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 544

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Huang Guangjie, Partner of Probe Capital

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 545

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr He Yaoping, Vice General Manager of Guoshu Lianren (Zhejiang) Medical and Health Management Co., Ltd

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 546

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

2 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Duan Sonwei, General Manager of WinX Capital Hangzhou Office

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Invitation for Model Evaluation Experts

Ref. No. MHESI 0643.14/ 553

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

9 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Ms Chen Hongxu, Vice General Manager of Zhejiang Tianda Intelligent Technology Co., Ltd.

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 554

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

9 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Zou Shaoyang, General Manager of Healthcare Incubator of Zhejiang University

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 555

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

9 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Wu Yingfang, Chairman of Hangzhou Shukang Medical Technology Group

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 556

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

9 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Si Ke, Director of Key Laboratory of First Affiliated Hospital, Zhejiang University School of Medicine .

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Ref. No. MHESI 0643.14/ 554

Graduate School
BansomdejchaoprayaRajabhat University
1061 Itsarapap 15 Itsarapap Rd.
Thonburi Bangkok 10600

9 April 2024

Subject Evaluation the consistency of management elements for innovation platform

Dear Mr Wu Yiming, Director of Information Department of Zhejiang Medical and Health Industry Group

Attachment Evaluation Form

Ms Tang Yuying is a graduate student in Doctor of Philosophy in Technology and Innovation Management Program at Bansomdejchaopraya Rajabhat University. She is undertaking research entitle "Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry" . There is a thesis advisory committee as follows:

1. Assoc. Prof.Dr.Natdanai Sighkhleewon	Major advisor
2. Assoc.Prof Dr Sombat Teekasap	Co-advisor
3. Dr.Sirigarn Phokheaw	Co-advisor

In this regard, the thesis advisory committee has considered that you are an expert in this topic. Your recommendations would be useful for further improvement of this research instrument. Therefore, permission was requested to allow the students to take the evaluation and set a date and time for students at your convenience.

We would like to avail ourselves of this opportunity to express our sincere thanks and appreciation for your help.

Sincerely,

(Assistant Professor Dr.Akaranun Asvarutpokin)
Vice Dean of Graduate School for Dean of Graduate School

Graduate School
Tel. +662-473-7000 ext. 1814
E-mail: grad@bsru.ac.th

Appendix C

Research Instrument

1. In-depth Interview Form
2. Elements Evaluation Form
3. Model Confirmation Form
4. Basic Information of in-depth Interview Experts
5. Basic Information of Elements Evaluation Experts
6. Basic Information of Model Confirmation Experts
7. Overview of Results of in-depth Interview
8. Database of Reference

In-Depth Interview Form

.....

Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry

Research objective

To develop the management model for innovation platform in medical Medical Artificial Intelligence Industry

Explanation

This is a research study focusing on the management model of medical artificial intelligence (hereafter referred to as AI) innovation platforms, aiming to provide references for advancing the development of the medical AI industry in China. This interview constitutes an integral part of the overall research project. We sincerely invite you as an expert in this field to share your insights and evaluations regarding the development of the medical AI industry and innovation platforms.

The anticipated duration of this interview will not exceed one hour. To ensure that we capture all your feedback, it may be necessary to record the session or take notes. Please be assured that all your comments and any personal information discussed during the interview will be treated with the utmost confidentiality. Please give your interview answers as truthfully and as possible as possible.

The interview is divided into 4 parts:

Part 1: General information of the interviewee

Part 2: Analysis of Difficulties and Challenges

Part 3: Analysis of Opportunities and Trends

Part 4: Analysis of Innovative Solutions

Part 1: General Information of the Interviewee.

1. Name.....

2. Age.....years

3. Highest educational qualification.....

4. Work experience.....years

5. Work place.....

6. Work position.....

Part 2: Analysis of Difficulties and Challenges

What do you perceive as the major difficulties and challenges(such as medical data, Algorithm, clinical application, Commercialization,Talents,Ethics and Laws, etc.) hindering the development of the medical AI industry? Could you please list them out?

2.1 Medical Data

Do you think medical data is one of the difficulties or challenges hindering the development of the medical AI industry? If yes, could you please list the major problems of medical data ?

2.2 Algorithm

Do you think Algorithm is one of the difficulties or challenges hindering the development of the medical AI industry? If yes, could you please list the major problems of Algorithm ?

2.3 Clinical Application

Do you think Clinical Application is one of the difficulties or challenges hindering the development of the medical AI industry? If yes, could you please list the major problems of Clinical Application ?

2.4. **Commercialization**

Do you think Commercialization is one of the difficulties or challenges hindering the development of the medical AI industry? If yes, could you please list the major problems of Clinical Application ?

2.5 Talents

Do you think Talents is one of the difficulties or challenges hindering the development of the medical AI industry? If yes, could you please list the major problems of Talents ?

2.6 Ethnics and Law

Do you think Ethnics and Law is one of the difficulties or challenges hindering the development of the medical AI industry? If yes, could you please list the major problems of Ethnics and Law ?

2.7 If you were to rank the aboved mentioned difficulties and challenges, what order would you place them in? And why?

Part 3: Analysis of Opportunities and Trends

3.1 Infrastructure Aspect

What aspects do you think to be concluded in the infrastructure supporting the development of the medical AI industry?

Currently, what advantages and disadvantages does China have in the infrastructure aspect? What changes should be made, and why?

3.2 Technology Innovation Aspect

What do you identify as the key core technologies driving the development of the medical AI industry?

In the aspect of the key core technologies, what are the current advantages and disadvantages that China possesses? What adjustments do you think should be made, and why?

What kind of talents does the development of medical artificial intelligence industry require? What actions should we take to meet the talent needs of the industry's development?

3.3 Application Scenario Aspect

What specific application scenarios do you envision for the medical AI industry?Which application scenarios have already been implemented in our China?

What measures do you think should be taken to further facilitate the practical implementation of the industry, and why?

3.4 Policies and Relations Aspect

What industrial policies and regulations do you believe are necessary to support the development of the medical AI industry?

What ethical considerations and governance mechanisms do you believe are necessary to regulate and supervise the development of the medical artificial intelligence industry?

Part 4: Analysis of Innovative Solutions

In terms of the innovation platform for the medical AI industry, what strategic measures, management tools, and solutions (such as platform sponsors, organizational structures, governance mechanism, etc.) can effectively promote the development of the industry?

Among these, which strategic measures, management tools, and solutions do you consider most crucial, and why?

Besides these points, what additional advice do you have for the future development of the medical AI industry?

Regarding innovation platforms in the field of medical AI, could you recommend three related domestic or international literature references?

Is there anything else you'd like to add or emphasize?

Research Evaluation Form

.....

Evaluation of Management Elements of Innovation Platform in Medical AI Industry

Research objective

to evaluate the management elements of innovation platform in medical AI industry

Explanation

This is a research on development of the management model for innovation platform in medical AI industry, which aims to provide reference for facilitating the development of medical AI industry. Based on literature analysis and in-depth interview, the researcher put forward the management elements for the innovation platform, which is divided into 5 aspects, 10 themes and 41 elements. This study adopts expert confirmation process to evaluate the consistency of management elements. You are invited to be an expert in this study and your suggestions will be an important basis for establishing management model for medical AI industry .

Comments are given to assess the consistency of the management elements of innovation platform. Please consider what is specified in each item. How consistent is it in practice? Then check ✓ in the box according to your opinion as follows:

Score level 5 means most consistent.

Score level 4 means very consistent.

Score level 3 means moderately consistent.

Score level 2 means less consistent.

Score level 1 means least consistent.

The last section “suggestions and reasons” asks you to express your opinions in order to make the details of the management elements more complete.

Open-ended questions are listed at the end of each episode. Please give additional comments or suggestions for the integrity of each aspect of the evaluation form.

Part 1: General information of the interviewee

Part 2: Management Elements of Infrastructure

Part 3: Management Elements of Technology Innovation

Part 4: Management Elements of Application Scenarios

Part 5: Management Elements of Policies and Regulations

Part 5: Management Elements of Platform Organization

Part 1: General Information of the Interviewee.

1. Name.....
2. Age.....years
3. Highest educational qualification.....
4. Work experience.....years
5. Work place.....
6. Work position.....

Part 2 : Management Elements of Infrastructure

Explanation: Please mark ✓ in the box for the level of consistency that you think is most appropriate for the management elements of innovation platform in medical AI industry, along with your comments, suggestions, and reasons (if any).

No.	Conformity Evaluation Items	Level of Compliance					Suggestions and Reasons (if any)
		5	4	3	2	1	
	Medical Data						
1	Establish medical data standards and norms						
2	Protect medical data privacy						
3	Form data pools and industry consensus						
4	Establish a mechanism for medical data integration						
	Algorithms						
1	Make the decision-making process fairness, accountability and transparency						
2	Improve algorithm accuracy						
3	Utilizing open-source algorithms, perform algorithm fine-tuning based on domain-specific data and knowledge.						

Additional comments or suggestions regarding infrastructure

.....

.....

Part 3 : Management Elements of Technology Innovation

Explanation: Please mark ✓ in the box for the level of consistency that you think is most appropriate for the management elements of innovation platform in medical AI industry, along with your comments, suggestions, and reasons (if any).

No.	Conformity Evaluation Items	Level of Compliance					Suggestions and Reasons (if any)
		5	4	3	2	1	
	Key Core Technologies						
1	Develop high-end chips						
2	Develop Large models						
3	Develop a domain knowledge base in order to unify rules for medical data and research consensus, as knowledge system is the foundation of developing medical AI industry						
4	Build a knowledge+data dual wheel driven technology platform (technical foundation), coupled with tool chains, to provide services for the industry						
5	Invest funds, policies, and talents by the government in the research and development of chips, algorithms, and key technologies						
	Innovative Talents						
1	Establish inter-disciplinary talent development system						
2	Cultivate interdisciplinary talents in medicine and AI						
3	To shorten the training period for interdisciplinary talents, medical professionals with an interest can be selectively chosen to undergo AI skills training.						

No.	Conformity Evaluation Items	Level of Compliance					Suggestions and Reasons (if any)
		5	4	3	2	1	
4	Encourage more people to participate in the medical AI industry, whether through incentive measures or commercial mechanisms						
5	The State should fund free training class for talents of this field and send people to developed countries for further education and provide full scholarship support						

Additional comments or suggestions regarding technology innovation

.....

.....

Part 4 : Management Elements of Application Scenarios

Explanation: Please mark ✓ in the box for the level of consistency that you think is most appropriate for the management elements of innovation platform in medical AI industry, along with your comments, suggestions, and reasons (if any).

No.	Conformity Evaluation Items	Level of Compliance					Suggestions and Reasons (if any)
		5	4	3	2	1	
	Clinical Applications						
1	Meet demands of segmented scenes						
2	Form integrated AI solutions for personalized diagnosis and treatment						
3	promote deep integration between clinical demands and AI technology						
	Commercialization						
1	Build business loop and pilot projects						
2	Innovative products should collaborate with leading enterprises as they understand industry needs, propose standards, and provide market channels						
3	Directly cooperating with large hospitals would be a better way to commercialize, as commercial resources and timely feedback are more important than others						
4	he government needs to guide the layout of the industrial chain, encourage a large enterprise to take the lead, and enable other enterprises to do a good job in the upstream and downstream links, forming an ecosystem						
5	to connect the industrial chain end to end through the integration of industry, academia,						

No.	Conformity Evaluation Items	Level of Compliance					Suggestions and Reasons (if any)
		5	4	3	2	1	
	and research, each link in the chain having a clear positioning and mutually supportive functions						

Additional comments or suggestions regarding application scenarios

.....

.....

Part 5 : Management Elements of Policies and Regulations

Explanation: Please mark ✓ in the box for the level of consistency that you think is most appropriate for the management elements of innovation platform in medical AI industry, along with your comments, suggestions, and reasons (if any).

No.	Conformity Evaluation Items	Level of Compliance					Suggestions and Reasons (if any)
		5	4	3	2	1	
	Industrial Policies						
1	Provide Industrial policies support helping to connect the entire industry chain						
2	The market needs to have an error-tolerant mechanism in regards to innovation.						
	Ethics and Law						
1	Issue regulation on new technologies						
2	Establish ethical governance						
3	Provide assistance to medical AI startups in addressing compliance issues						
4	Policies and regulations should be predictable and sustainable						
5	Priority should be given to products that have passed project review and approval for entering clinical application						

Additional comments or suggestions regarding policies and regulations

.....

.....

Part 6 : Management Elements of Platform Organization

Explanation: Please mark ✓ in the box for the level of consistency that you think is most appropriate for the management elements of innovation platform in medical AI industry, along with your comments, suggestions, and reasons (if any).

No.	Conformity Evaluation Items	Level of Compliance					Suggestions and Reasons (if any)
		5	4	3	2	1	
	Role Positioning						
1	Integrate various innovative elements to support innovation activities						
2	Accelerate multi-scenario applications						
3	Connecting and sharing						
	Development Trend and Suggestions						
1	Establish organizational structure system and collaborative mechanisms						
2	Top-level design and build open innovation ecosystem						
3	Develop its own underlying algorithms and large model for industry use						
4	Incubate startups with core technologies and provide policy implementation to support the growth of startups						
5	Provide clinical resources and application scenario						
6	Provide commercialization and promotion supports						

Additional comments or suggestions regarding platform organization

.....

.....

Research Confirmation Form

.....

Confirmation of Management Model of Innovation Platform in Medical AI Industry

Research objective

to confirm the management model of innovation platform in medical AI industry

Explanation

This is a research on development of the management model for innovation platform in medical AI industry, which aims to provide reference for facilitating the development of medical AI industry. Based on management elements, the researcher creates the management model for the innovation platform, which consists of 5 aspects, 11 themes and 35 elements. This study adopts expert confirmation process to confirm the consistency of management model. You are invited to be an expert in this study and your suggestions will be an important basis for evaluating management model for medical AI industry.

Comments are given to assess the consistency of the management model of innovation platform. Please consider what is specified in each item. How consistent is it in practice? Then check ✓ in the box according to your opinion as follows:

Score level 5 means most consistent.

Score level 4 means very consistent.

Score level 3 means moderately consistent.

Score level 2 means less consistent.

Score level 1 means least consistent.

The last section “suggestions and reasons” asks you to express your opinions in order to make the details of the management model more complete. Open-ended questions are listed at the end of each episode. Please give additional comments or suggestions for the integrity of each aspect of the evaluation form.

Part 1: General information of the interviewee

Part 2: Infrastructure Management

Part 3: Technology Innovation Management

Part 4: Application Scenario Management

Part 5: Policy and Regulation Management

Part 5: Platform Organization Management

Part 1: General Information of the Interviewee.

1. Name.....
2. Age.....years
3. Highest educational qualification.....
4. Work experience.....years
5. Work place.....
6. Work position.....

Part 2 : Infrastructure Management

Explanation: Please mark ✓ in the box for the level of consistency that you think is most appropriate for the management elements of innovation platform in medical AI industry, along with your comments, suggestions, and reasons (if any).

No.	Conformity Evaluation Items	Level of Compliance					Suggestions and Reasons (if any)
		5	4	3	2	1	
	Medical Data						
1	Establish medical data standards and norms						
2	Protect medical data privacy						
3	Form data pools and industry consensus						
4	Establish a mechanism for medical data integration						
	Algorithms						
1	Make the decision-making process fairness, accountability and transparency						
2	Improve algorithm accuracy						
3	Utilizing open-source algorithms, perform algorithm fine-tuning based on domain-specific data and knowledge.						
	Computing Power						
1	Introduce cloud service providers or construct public computing power supply to reduce research and development costs within the platform						
2	Through purchasing computing power to comprehensively enhance the platform's innovation capabilities and empower medical start-ups and other entities on the platform						

Additional comments or suggestions regarding infrastructure

.....

.....

Part 3 : Technology Innovation Management

Explanation: Please mark ✓ in the box for the level of consistency that you think is most appropriate for the management elements of innovation platform in medical AI industry, along with your comments, suggestions, and reasons (if any).

No.	Conformity Evaluation Items	Level of Compliance					Suggestions and Reasons (if any)
		5	4	3	2	1	
	Key Core Technologies						
1	Develop a domain knowledge base in order to unify rules for medical data and research consensus, as knowledge system is the foundation of developing medical AI industry						
2	Build a knowledge+data dual wheel driven technology platform (technical foundation), coupled with tool chains, to provide services for the industry						
	Innovative Talents						
1	Establish inter-disciplinary talent development system						
2	Cultivate interdisciplinary talents in medicine and AI						
3	To shorten the training period for interdisciplinary talents, medical professionals with an interest can be selectively chosen to undergo AI skills training.						
4	Encourage more people to participate in the medical AI industry, whether through incentive measures or commercial mechanisms						

Additional comments or suggestions regarding technology innovation

.....

.....

Part 4 : Application Scenario Management

Explanation: Please mark ✓ in the box for the level of consistency that you think is most appropriate for the management elements of innovation platform in medical AI industry, along with your comments, suggestions, and reasons (if any).

No.	Conformity Evaluation Items	Level of Compliance					Suggestions and Reasons (if any)
		5	4	3	2	1	
	Clinical Applications						
1	Meet demands of segmented scenes						
2	promote deep integration between clinical demands and AI technology						
	Commercialization						
1	Build business loop and pilot projects						
2	Innovative products should collaborate with leading enterprises as they understand industry needs, propose standards, and provide market channels						
3	Directly cooperating with large hospitals would be a better way to commercialize, as commercial resources and timely feedback are more important than others						
4	the government needs to guide the layout of the industrial chain, encourage a large enterprise to take the lead, and enable other enterprises to do a good job in the upstream and downstream links, forming an ecosystem						

Additional comments or suggestions regarding application scenarios

.....

.....

Part 5 : Policy and Regulation Management

Explanation: Please mark ✓ in the box for the level of consistency that you think is most appropriate for the management elements of innovation platform in medical AI industry, along with your comments, suggestions, and reasons (if any).

No.	Conformity Evaluation Items	Level of Compliance					Suggestions and Reasons (if any)
		5	4	3	2	1	
	Industrial Policies						
1	The market needs to have an error-tolerant mechanism in regards to innovation.						
	Ethics and Law						
1	Establish ethical governance						
2	Provide assistance to medical AI startups in addressing compliance issues						
3	Policies and regulations should be predictable and sustainable						
4	Priority should be given to products that have passed project review and approval for entering clinical application						

Additional comments or suggestions regarding policies and regulations

.....

.....

Part 6 : Platform Organization Management

Explanation: Please mark ✓ in the box for the level of consistency that you think is most appropriate for the management elements of innovation platform in medical AI industry, along with your comments, suggestions, and reasons (if any).

No.	Conformity Evaluation Items	Level of Compliance					Suggestions and Reasons (if any)
		5	4	3	2	1	
	Role Positioning						
1	Integrate various innovative elements to support innovation activities						
2	Accelerate multi-scenario applications						
3	Connecting and sharing						
	Development Trend and Suggestions						
1	Establish organizational structure system and collaborative mechanisms						
2	Top-level design and build open innovation ecosystem						
3	Develop its own underlying algorithms and large model for industry use						
4	Incubate startups with core technologies and provide policy implementation to support the growth of startups						
5	Provide clinical resources and application scenario						
6	Provide commercialization and promotion supports						

Additional comments or suggestions regarding platform organization

.....

.....

Appendix D

The Results of the Quality Analysis of Research Instruments

Basic information of Experts for In-depth Interview

NO.	Education	Professional	Work experience	Position	Work Organization
Expert 1	Bachelor degree	Computer Science	36 years	Vice manager	Medical Ai Listed company
Expert 2	Doctor degree	Medical AI	10 years	Research fellow	University
Expert 3	Master degree	Computer Science	23 years	Director	Research institute
Expert 4	Master degree	Medical Laboratory& Businesses Management	17 years	Funder	Medical AI Start-up
Expert 5	Master degree	Clinical Medicine	38 years	CEO	Investor

Basic information of Experts for Elements Evaluation

NO.	Education	Profession	Work experience	Position	Work Organization
Expert 1	Master degree	Information Engineering	17 years	Vice president	Medical AI Start-up
Expert 2	Master degree	Computer Science	18 years	Vice president	Listed Company
Expert 3	Bachelor degree	Medical AI	27 years	Partner	Investor
Expert 4	Doctor degree	Physics	5 years	Professor	University
Expert 5	Master degree	Information Engineering	24 years	Vice General Manager	Medical AI Start-up
Expert 6	Bachelor degree	Public Management	10 years	Partner	Investor
Expert 7	Master degree	Computer Science	15 years	Product Development Manager	Medical AI Start-up
Expert 8	Master degree	Information Engineering	8 years	Marketing Manager	Medical AI Start-up
Expert 9	Master degree	Clinical Medicine	24 years	Vice General Manager	Listed Company
Expert 10	Master degree	Healthcare Management	16 years	Operation Director	Medical AI Start-up
Expert 11	Master degree	Public Administration	13 years	Government Officials	Government Department

Basic information of Experts for Elements Evaluation (continued)

NO.	Education	Profession	Work experience	Position	Work Organization
Expert 12	Doctor degree	Clinical Medicine	5 years	General Manager	Investor
Expert 13	Bachelor degree	Artificial Intelligence	23 years	Sales Director	Listed Company
Expert 14	Doctor degree	Clinical Medicine	18 years	Deputy Dean	Hospital
Expert 15	Master degree	Computer Science	5 years	CTO	University Incubator
Expert 16	Doctor degree	Clinical Medicine	21 years	Chief Physician	Hospital
Expert 17	Bachelor degree	Computer Science	13 years	CEO	Medical AI Start-up

Basic information of Experts for Model Confirmation

NO.	Education	Professional	Work experience	Position	Work Organization
Expert 1	Master degree	Business Administration	25 years	Chairmen	Investor
Expert 2	Doctor degree	Clinical Medicine	10 years	Director	Hospital
Expert 3	Master degree	Business Administration	10 years	General Manager	Research institute
Expert 4	Master degree	Information Engineering	25 years	Vice General Manager	Medical AI Start-up
Expert 5	Bachelor degree	Computer Science	38 years	Director	Listed Company

Overview of results of in-depth Interview

Aspects	Themes	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5
Problems and Challenges	Medical Data	(1) Scattered and low quality data (2) Lack of standards (3) Data privacy protection issues	Lack of data standards and unified rules	Lack of standards for the data collection, affecting the data accuracy	(1) Lack of standards and unified rules (2) Data privacy protection issues causing the data authenticity problems	(1) Lack of data standards and unified rules (2) Low quality data
	Algorithm	without their own core algorithms, most Chinese companies use fine-tuned model on foreign open-source algorithms	Without their own core algorithms	lack of high-performance computing chips, affecting algorithm innovation and development	Unable to develop their own large models, using fine-tuned model on foreign open-source algorithms	Without their own core algorithms

Overview of results of in-depth Interview (continued)

Aspects	Themes	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5
Problems and Challenges	Clinical Applications	(1) The integration of AI technology and application scenarios needs to be improved (2) Product launch approval is time consuming	There are problems with the integration of AI technology and clinical demands	(1) Poor matching between AI technology and clinical workflow (2) AI products cannot adapt to various application Scenarios automatically, it take a long time to retrain and correct AI	Lack of clinical performance evaluation system for medical AI product, affecting product approval and application	(1) Most Medical AI products are still in the research and experimental stage, and there is still a certain gap with clinical applications (2) Product launch approval is time consuming
	Talents	Lack of interdisciplinary talents	(1) Lack of interdisciplinary talents between medicine and AI (2) Major universities have not yet established interdisciplinary talent training systems	Lack of interdisciplinary talents	(1) Lack of interdisciplinary talents who know both clinical and computer science. (2) Its difficult to cultivate interdisciplinary talents of clinical and computer in a short time	Lack of interdisciplinary talents between medicine and AI

Overview of results of in-depth Interview (continued)

Aspects	Themes	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5
Problems and Challenges	Commercialization	small profit margin for medical AI products	(1) Unclear business model (2) Weak product strength	Unclear business model because AI products cannot form standardized products	Medical inclusive pricing determines a small profit margin for products and lack of reasonable pricing mechanisms to support cost recovery for innovative products	(1) Unclear business model (2) Weak product strength
	Ethnics and Law	Lagging laws and regulations are unable to effectively support the legal and compliant application of innovative products	Ethics do not receive as much attention in China as abroad	Lagging laws and regulations are unable to effectively support the legal and compliant application of innovative products	Lagging laws and regulations are unable to effectively support the legal and compliant application of innovative products	Lagging laws and regulations are unable to effectively support the legal and compliant application of innovative products
	Problems and challenges sorting	(1) Talents challenge ranks the most importance among all issues	(1) Talents challenge ranks the most importance among all issues	(1) Talents challenge ranks the most importance among all issues	(1) Talents challenge ranks the most importance among all issues	(1) Talents challenge ranks the most importance among all issues

Overview of results of in-depth Interview (continued)

Aspects		Themes	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5
				(2) Clinical application issues rank second (3) Commercialization problems rank third	(2) Algorithm and core technologies challenges rank second (3) Clinical application issues rank third	(2) Laws and regulations issues rank second (3) Core technologies challenges rank third	(2) Clinical application issues rank second (3) Algorithm and core technologies challenges rank third
Opportunities and Trends	Infrastructure	Medical Data	establish a mechanism for medical data integration	Form medical data pools based on the advantages of abundant data and diverse scenarios in China	establish medical data standards and norms	(1) Establish data standards and norms (2) Form data pools and industry consensus	establish medical data standards and norms
		Algorithms	Utilizing open-source algorithms, perform algorithm fine-tuning based on domain-specific data and knowledge.	Improve algorithm accuracy	improve algorithm accuracy	Utilizing open-source algorithms, perform algorithm fine-tuning based on domain-specific data and knowledge.	improve algorithm accuracy

Overview of results of in-depth Interview (continued)

Aspects	Themes	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5
Technology Innovation	Key Core Technologies	(1) Develop high-end chips (2) Develop Large models (3) Develop universal knowledge base for medical field	(1) Develop domain knowledge base to unify rules for medical data and research consensus, as knowledge system is the foundation of developing medical AI industry (2) Build knowledge+data dual wheel driven technology platform (technical foundation), coupled with tool chains, to provide services for the industry	Invest funds, policies, and talents by the government in the research and development of chips, algorithms, and key technologies	(1) Universities use national funding to develop large-scale models (2) Enterprises engage in applied product research and development	Invest funds, policies, and talents by the government in the research and development of chips, algorithms, and key technologies

Overview of results of in-depth Interview (continued)

Aspects		Themes	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5
Opportunities and Trends	Technology Innovation	Innovative Talents	(1) Cultivate interdisciplinary talents in medicine and AI (2) Build interdisciplinary talent training system	(1) Cultivate interdisciplinary talents in medicine and AI (2) In order to shorten the training time, doctors can be selected for training AI skills. (3) Build interdisciplinary talent training system	(1) State should fund free training class for talents of this field (2) Send people to developed countries for further education and provide full scholarship support	Encourage more people to participate in the medical AI industry, whether through incentive measures or commercial mechanisms	(1) Cultivate interdisciplinary talents in medicine and AI (2) Build interdisciplinary talent training system
	Application Scenario	Clinical Applications	promote deep integration between clinical demands and AI technology	promote deep integration between clinical demands and AI technology	promote deep integration between clinical demands and AI technology	promote deep integration between clinical demands and AI technology	promote deep integration between clinical demands and AI technology

Overview of results of in-depth Interview (continued)

Aspects		Themes	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5
Opportunities and Trends	Application Scenario	Commercialization	Innovative products should collaborate with leading enterprises as they understand industry needs, propose standards, and provide market channels	Directly cooperating with large hospitals would be a better way to commercialize, as commercial resources and timely feedback are more important than others	The government needs to guide the layout of the industrial chain, encourage a large enterprise to take the lead, and enable other enterprises to do a good job in the upstream and downstream links, forming an ecosystem. Government needs to screen a group of high-quality enterprises and support their growth	to connect the industrial chain end to end through the integration of industry, academia, and research, each link in the chain having a clear positioning and mutually supportive functions	to connect the industrial chain end to end through the integration of industry, academia, and research, each link in the chain having a clear positioning and mutually supportive functions

Overview of results of in-depth Interview (continued)

Aspects		Themes	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5
Opportunities and Trends	Policies and Regulations	Industrial Policies	(1) Policy support helps to connect the entire industry chain (2) The market needs to have an error-tolerant mechanism in regards to innovation.	Policy support helps to connect the entire industry chain	Policy support helps to connect the entire industry chain	(1) Policy support helps to connect the entire industry chai (2) The market needs to have an error-tolerant mechanism in regards to innovation.	Policy support helps to connect the entire industry chain
		Ethics and Law	Provide assistance to medical AI startups in addressing compliance issues	Policies and regulations should be predictable and sustainable	(1) Policies and regulations should be predictable and sustainable (2) Priority should be given to products that have passed project review and approval for entering clinical application	the assistance is needed for medical AI startups to address compliance issues	Policies and regulations should be predictable and sustainable

Overview of results of in-depth Interview (continued)

Aspects		Themes	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5
Innovative Solutions of Innovation Platform	Platform Organization	Role Positioning	Connection and sharing	The platform needs to have a clear positioning for what it can provide	Connection and sharing	The role played by the innovation platform is not obvious	The role played by the innovation platform is not obvious
		Development Trend and Suggestions	(1) Develop its own underlying algorithms and large model for industry use (2) Incubate startups with core technologies, such as chip development companies	(1) Provide industrial resource and commercialization support (2) Provide policy implementation to support the growth of startups (3) Link various resources	(1) Provide technology R&D resources (2) Provide clinical resources and application scenario (3) Provide commercialization and promotion supports (4) The relations between platform and start-ups could be service outsourcing, equity cooperation, and other market-oriented cooperation methods	(1) Connect channels and establish relationships (2) Link various resources (3) Sharing platform	(1) Connect various resources (2) Provide commercialization support

Overview of results of in-depth Interview(continued)

Aspects	Themes	Expert 1	Expert 2	Expert 3	Expert 4	Expert 5
Other suggestions from Interviewee				The medical industry is highly specialized and policy driven, so further specialized research is needed to solve certain problems		

Database of Reference

No.	Name of Database	Number of Reference
1	CNKI	69
2	CQVIP	16
3	China Online Journals	7
4	SCIENCEDIRECT	21
5	IEEE	11
6	Web of Science	8
7	Wiley Online Library	2
Total		**134**

Appendix E

Certificate of English

BANSOMDEJCHAOPRAYA
RAJABHAT UNIVERSITY

This is to certify that

Tang Yuying

Achieved BSRU English Proficiency Test (BSRU-TEP) level

C2

Given on 25th January 2021

(Assistant Professor Dr Kulsirin Aphiratvoradej)

Director

Appendix F

The Document for Acceptance Research

มหาวิทยาลัยธนบุรี
THONBURI UNIVERSITY

วันที่ 11 มิถุนายน 2567

ที่ วธว. 2/2567

เรื่อง รับรองผลงานเพื่อตีพิมพ์ในวารสารวิทยาศาตร์และเทคโนโลยี มหาวิทยาลัยธนบุรี

เรียน Yuying Tang Nutdanai Singkhleewon Sirikarn Pokheow Sombat Teekasap

ตามที่ท่าน ได้จัดส่งบทความวิจัยเรื่อง **Development of Management Model for Innovation Platform in Medical Artificial Intelligence Industry** เพื่อขอตีพิมพ์ในวารสารวิทยาศาตร์และเทคโนโลยี มหาวิทยาลัยธนบุรี ทางกองบรรณาธิการได้นำเรื่องของท่านเข้าสู่กระบวนการพิจารณาจากคณะกรรมการกลั่นกรอง (Peer Review) และการตรวจสอบจากกองบรรณาธิการประจำวารสารเรียบร้อยแล้ว มีความยินดีที่จะแจ้งให้ท่านทราบว่า บทความวิจัยของท่านจะได้รับการตีพิมพ์ในวารสารวิทยาศาตร์และเทคโนโลยี มหาวิทยาลัยธนบุรี ปีที่ 8 ฉบับที่ 1 (มกราคม – มิถุนายน 2567)

จึงเรียนมาเพื่อโปรดทราบ

ขอแสดงความนับถือ

(ดร.ฐิติพร กรัยวิเชียร)
กองบรรณาธิการวารสารวิชาการ
มหาวิทยาลัยธนบุรี

กองบรรณาธิการ วารสารวิชาการมหาวิทยาลัยธนบุรี
โทร. 02-8090823-5. ต่อ 113 โทรสาร. 0-2809-0832

Researcher Profile

Name	Ms. Tang Yuying
Date of birth	November 17, 1975
Place of birth	Yunhe, Zhejiang
Education Background	2003 Undergraduate, Zhejiang University, Clinical Medicine; 2010 Graduate, Zhejiang University, Master of Business Administration; 2021 PhD candidate, Bansomdejchaopraya Rajabhat University, Thailand, Technology and Innovation Management.
Work Experience	003.01--2007.02 Hangzhou Dalishen Medical Equipment Co., Ltd. Chief Representative Overseas 2007.02- 2009.08 Shanghai Gamma Star Medical Group Co., Ltd. Chief Representative Overseas 010.10-2011.10 Kuka Home Furnishings Group Co., Ltd. Director of Key Account Department of International Sales Center 2011.11-2013.01 Hangzhou Dunli Medical Equipment Co., Ltd General Manager 2015.05-2021.06 Hangzhou Letsfun Technology Co., Ltd Founder 2021.07-now Insigma STIID Group Co., Ltd.
Address	Hangzhou of China
Post	Vice President