福建省中电海峡智能装备研究院
Fujian Zhongdian Straits Institute of Intelligent Equipment
Asia Pacific Science Press
Advances in Management and Intelligent Technologies
ISSN(O):3079-5869
ISSN(P):3079-5850
Vol. 1 No.3 (2025)

Research on the Synergistic Mechanism of Strategic Innovation and Technological Progress —— An Empirical Analysis Based on the Organizational Performance of the Medical Industry

Chung Muhui*, Oyyappan Duraipandi, Dhakir Abbas Ali, Rozaini Rosli
Management,Faculty of Business And Accountancy,Lincoln University College, Petaling Jaya, Selangor, 47301, Malaysia
Corresponding author: Chung Muhui , chungmu@lincoln.edu.my

Abstract: This study systematically explores the theoretical framework and practical pathways of the synergy mechanism between strategic innovation and technological progress in the healthcare industry. The research finds that the strong regulatory nature, long R&D cycle, and multi-party participation of the healthcare industry give rise to a unique characteristic of "dynamic equilibrium under constraints" in its synergy mechanism. A theoretical model is constructed, encompassing three dimensions of strategic innovation (disruptive, open, ecological), three types of technological progress (breakthrough, incremental, integrative), and three levels of synergy mechanisms (element coupling, dynamic adaptation, value co-creation). Based on the theories of innovation ecosystems, technology tracks, and dual organizational capabilities, an analytical framework combining macro, meso, and micro perspectives is formed. The study also reveals coordination barriers faced by the healthcare industry, such as intellectual property barriers, policy lag, and coordination costs, providing a systematic solution to the "innovation island" dilemma.

Keywords: Strategic Innovation; Technological Progress; Collaborative Mechanism; Medical Industry; Organizational Performance
Published: Jun 23, 2025
DOI:https://doi.org/10.62177/amit.v1i3.480

1.Introduction

This study explores the mechanism by which strategic innovation and technological progress in the healthcare industry jointly drive organizational performance. Based on dynamic capability theory, a "strategy-technology-performance" analytical framework is constructed to reveal the synergistic paths between the two under special medical circumstances. The findings indicate that strategic innovation provides direction and resources for technology application, while technological progress enhances the effectiveness of strategy implementation. Their synergy can overcome the limitations of individual innovations. The strong regulation and long cycles characteristic of the healthcare sector make the synergistic mechanism exhibit features of "dynamic equilibrium under constraints," necessitating a balance between innovative breakthroughs and robust compliance. This research offers theoretical guidance to address the issue of "innovation silos" in the healthcare field, suggesting the need to strengthen both strategic flexibility and technology absorption capabilities to build an ecosystem for continuous innovation. For policymakers, it is essential to optimize the institutional environment to promote synergy; for healthcare managers, a dynamic matching mechanism for technology foresight and strategic adjustment should be established.

2.The theoretical framework for the synergy between strategic innovation and technological progress

2.1 Definition of core concepts

The system analyzes the synergistic mechanism between strategic innovation and technological progress in the healthcare industry. Healthcare organizations achieve systemic transformation by reconstructing their diagnostic and treatment systems, integrating resources, and building collaborative networks through various types of innovation. Technological progress is characterized by stepwise development, encompassing breakthrough, incremental, and convergent technologies, which collectively form the healthcare technology innovation system. These two dimensions work in synergy through dynamic coupling mechanisms, including element coupling, process adaptation, and value co-creation, forming a dual-driven model. This model adapts to the characteristics of the healthcare industry, providing theoretical support for the healthcare innovation system and revealing the dialectical relationship between strategy and technology, offering a framework for sustainable development in healthcare institutions[1].

2.2 Theoretical basis of the coordination mechanism

A multi-level theoretical framework has been constructed, integrating the theories of innovation ecosystems, technology tracks, and organizational dual capabilities to explain strategic innovation and technological progress in the healthcare industry. The theory of innovation ecosystems illustrates how diverse entities build innovation networks, forming an ecological chain from research and development to application. The theory of technology tracks analyzes path dependence and breakthroughs in the evolution of medical technologies, emphasizing the importance of technology planning and organizational design. The theory of organizational dual capabilities elucidates how healthcare institutions balance innovation and optimization, adjusting strategies according to the environment. These theories complement each other, providing a structural foundation, dynamic evolution patterns, and implementation effectiveness for innovation in the healthcare industry, forming a systematic theoretical tool to help healthcare organizations achieve high-quality development amid rapid technological iterations and policy changes[2].

2.3 Analysis of collaborative characteristics in the medical industry

The healthcare industry, as a technology-intensive and heavily regulated sector, exhibits unique complexities in its strategic innovation and technological advancement synergy mechanisms. The high regulatory environment not only restricts the freedom of innovation but also promotes technical standardization; long R&D cycles require organizations to have long-term capability reserves; while the multi-party innovation ecosystem faces coordination challenges, it also facilitates resource complementarity and value co-creation. These characteristics necessitate that the healthcare synergy mechanism seeks balance under multiple constraints. At the same time, the synergy process in the healthcare industry encounters obstacles such as intellectual property protection, policy lag, technological development gaps, and high inter-organizational cooperation transaction costs. These obstacles interact, forming a “synergy dilemma” in healthcare innovation. The industry’s uniqueness and synergy barriers reinforce each other, requiring healthcare organizations to adopt a systemic approach when building synergy mechanisms, balancing innovation with risk management to achieve sustainable high-quality development[3].

3.The mechanism of strategic innovation and technology progress coordination mechanism

3.1 Synergistic path at the strategic orientation level

In the healthcare industry, strategic innovation and technological progress achieve synergies through the critical path:

3.1.1 Technology foresight and strategic goal matching mechanism

The strategy of medical organizations needs to be based on technology trends. The matching mechanism includes:

Forward-looking Technology Assessment: Scanning the clinical application potential of emerging technologies to inform strategic planning. For example, hospitals assess how quantum computing can enhance drug development efficiency. Strategic Goal Decomposition: Transforming macro-strategies into specific technical solutions. For instance, breaking down the goal of improving diagnostic accuracy into introducing AI diagnostic systems and building a gene testing platform. Dynamic Adjustment Mechanism: Establishing a strategic-technical feedback loop to regularly evaluate the alignment between

technology implementation outcomes and strategic goals, and promptly adjust the [4].

3.1.2 Two-way reinforcement of dynamic capability construction

The coordinated development of strategic flexibility and technology absorption ability is the core power of continuous innovation of an organization:

The strategic value of technology absorption capability: including the ability to identify external technological value, digestion and integration capabilities, and commercial application capabilities. These capabilities influence the depth and breadth of strategic innovation. The technical support for strategic flexibility: the organization's ability to quickly adjust its strategic direction, which relies on modular technical architecture, cross-departmental collaboration mechanisms, and agile management processes.

Two-way strengthening mechanism: the enhanced technology absorption ability enables the organization to respond to the technological changes required by strategic adjustment more quickly; at the same time, the strategic flexibility provides institutional guarantee for technology absorption.

This kind of synergy is essentially to achieve a virtuous cycle of organizational innovation ecology by establishing a technology-driven strategic decision-making system and a technology development path led by strategy. The medical industry needs to emphasize the balance of innovation under the compliance framework, avoid policy risks caused by technological adventurism, and prevent technological lag caused by strategic conservatism[5].

3.2 Synergy mode at the level of resource integration

In the medical industry, the synergistic mode of resource integration is very important. It not only breaks through the limitations of traditional resource allocation, but also realizes synergistic effect through systematic integration. This part will discuss two core synergistic modes.

The first is the systematic construction of the knowledge sharing platform, which is evolving from one-way transmission to multi-subject interaction. The collaborative value is reflected in three dimensions:

Data interoperability architecture: Establish a cross-institutional data platform to realize standardized docking of different data. For example, using federal learning technology to realize joint modeling of multi-party medical image data under the premise of privacy protection.

Knowledge transformation mechanism: Establish a transformation chain from basic research to clinical application. The discovery of scientific research institutions can be quickly transmitted to pharmaceutical companies through the platform, and clinical feedback can guide basic research [6].

Collaborative innovation network: to form a problem-oriented distributed innovation community. For specific diseases, hospitals, enterprises and scientific research institutions can achieve precise matching of innovation elements through the platform.

3.2.2 Dynamic formation of complementary resource pool

Resource collaboration in the healthcare industry has evolved into a deeply complementary ecosystem:

Property collaboration model: Patent alliances reduce innovation barriers through cross-licensing, such as the construction of patent pools in the field of genetic testing, and accelerate technology standardization. Joint laboratories realize the intensive use of equipment, talents and funds, and integrate clinical resources, algorithm capabilities and theoretical research.

Talent flow mechanism: Establish a system to promote the flow of talents among industry, university and research institutes. Clinical doctors participate in R&D to ensure product applicability, engineers stay in hospitals to improve the efficiency of technology implementation, and researchers rotate in clinical practice to enhance problem orientation. Flow promotes the transfer of explicit knowledge and the exchange of tacit experience.

Risk sharing system: R&D risks are dispersed through innovation consortia. In the research and development of major medical equipment, hospitals define the needs, enterprises lead the development, and insurance institutions provide risk protection to form an innovation investment mechanism.

3.3 Dynamic evolution of collaborative mechanism

In the medical innovation ecosystem, strategic innovation and technological progress show complex dynamic evolution

characteristics, including gradual adaptation and breakthrough change. The synergistic mechanism is reflected in two aspects:

3.3.1 Feedback loop of technology iteration and strategic adjustment

Medical technology progress and strategic innovation interact:

Technology-driven strategic evolution: When new technologies accumulate to a certain extent, they promote the restructuring of strategic frameworks. For example, 3D bioprinting technology has prompted hospitals to move towards precision medicine.

Strategy leads technology development: forward-looking strategy guides the direction of technology research and development. After a medical group implements the smart hospital strategy, it invests in Internet of Things, big data and other technologies to form a closed loop.

Dynamic balance mechanism: establish a feedback system of monitoring, evaluation and adjustment. The key links include technology maturity assessment, strategic adaptability analysis and resource allocation flexibility.

3.3.2 Critical point mechanism of nonlinear synergistic effect

The co-evolution of the medical industry presents nonlinear characteristics:

Leap from quantitative to qualitative change: when variables such as technical performance, policy environment and market demand break through the critical value, a fundamental change in the strategic paradigm is triggered. For example, when the accuracy of AI diagnosis exceeds 95% and is recognized by regulations, hospitals will turn to an AI-first strategy.

Path dependence and breakthrough: the formation of inertia constraints in the existing technology system may create a strategic window period when disruptive technologies emerge. Organizations need to identify turning points, such as predicting the timing of transformation through technology road maps.

Compound effect amplification: The cross-fusion of different technology fields generates exponential innovation opportunities, which requires the strategic system to have the ability of portfolio management. It is necessary to establish a technology correlation analysis matrix to identify the technology portfolio with strategic synergy potential.

4.The impact path of the collaborative mechanism on the performance of medical industry organizations

4.1 Pathways to improve innovation performance

In the innovation ecosystem of the healthcare industry, the synergy between strategic innovation and technological progress plays a multifaceted role in enhancing organizational innovation performance. This impact primarily unfolds through two key pathways: paradigm shifts in R&D and the realization of intellectual property value, jointly driving medical organizations to improve their innovation efficiency from basic research to clinical translation[7].

4.1.1 Paradigm optimization of R&D efficiency

The synergy mechanism significantly improves the efficiency of medical innovation:

Application of intelligent technology tools: The introduction of artificial intelligence and big data technologies, machine learning algorithms to rapidly screen drug candidate molecules, and preclinical research cycles from years to months; digital twin technology to build virtual patient models, reducing clinical trial costs. These technologies shift research and development from experience-driven to data-driven.

Construction of interdisciplinary collaboration platform: Under the guidance of open innovation, hospitals, universities and enterprises establish joint R&D centers to share resources and achieve seamless connection. For example, cancer hospitals cooperate with gene sequencing companies to improve the efficiency of targeted drug research and development by more than 40%.

Introduction of agile management method: Medical R&D projects adopt the concept of iterative development, set up independent test-feedback cycle, and avoid the risk of late rework in traditional R&D [8].

4.1.2 Deep expansion of the patent value chain

Collaborative mechanism to improve the quantity and quality of patents, and reshape the commercial value of medical intellectual property rights:

The patent layout oriented by clinical needs ensures technological innovation and market application. This model reduces the

patent dormancy rate, such as the patent conversion rate of a cardiovascular device enterprise increased to 68%.

Build a patent portfolio, including core technologies, supporting processes and clinical application methods, and obtain sustained revenue through patent licensing. For example, the three-level protection system in the field of minimally invasive surgical instruments.

The application of digital technology creates new channels for patent value realization. For example, blockchain technology ensures the credibility of patent traceability, smart contract automatically settles authorization fees, and big data analysis matching technology matches supply and demand. These innovations reduce the cost of patent transaction by more than 30%.

The deeper value of innovative performance improvement lies in changing the measurement dimensions: shifting from the scale of R&D investment to the intelligence level of innovation processes; from pursuing the number of patents to the ecological operation of intellectual property. Collaboration in the healthcare industry must be based on ethical review and quality control, demonstrating robust innovation characteristics. In the future, as frontier technologies mature, the synergistic mechanism's role in promoting innovation performance will be exponentially amplified.

4.2 Operation performance optimization path

The medical industry improves its operational performance through strategic innovation and technological progress, mainly in the process efficiency innovation and risk management system reconstruction:

4.2.1 Intelligent process reengineering of the whole value chain

Build an intelligent operation system: introduce Internet of Things and blockchain technology to realize the whole process traceability of drugs. Intelligent prediction algorithm improves the inventory turnover rate by more than 30% and reduces drug loss.

Digital reshaping of clinical pathways: integrating electronic medical records and other information systems to establish closed-loop management of diagnosis and treatment processes. The intelligent scheduling system reduces preoperative waiting time by 25%.

Dynamic optimization of resource scheduling: Bed management system based on 5G and edge computing, realizing intelligent redistribution of bed resources, and improving the utilization rate of beds by 8-12 percentage points.

4.2.2 Technology-enabled three-dimensional risk control system

Build a real-time monitoring and early warning network: using AIoT technology to achieve millisecond response of medical quality monitoring matrix. Automatic emergency plan is triggered by abnormal data to shorten the time of discovering medical adverse events.

Flexible design strategy redundancy: form a double-layer drug reserve structure to ensure the stability of drug supply and respond quickly to breakthrough therapies. Show advantages in public health emergencies.

Forward-looking risk modeling: Establish a medical accident risk prediction model by combining big data and machine learning. Analyze dispute cases, identify risk sources, and improve the incidence of medical disputes by 40%.

4.3 Social performance expansion path

The amplification effect of the synergy mechanism on the social value of medical organizations is realized through two strategic channels: brand building and industry influence:

4.3.1 Brand premium of technology-strategy synergy

Differentiated value proposition shaping: The hospital deeply integrates advanced technology applications (such as proton therapy) with its distinctive strategic positioning (specialized in oncology), establishing a brand perception of "technical expertise" in patients' minds. A specialized hospital increased the proportion of high-end patients by 15% through the dissemination of cases involving da Vinci robotic surgery.

Brand spillover of innovation ecology: When leading the formation of cross-regional medical consortia, technological innovation capability is taken as the core attraction. By exporting intelligent diagnosis and treatment systems and management standards, a positive cycle of "technology brand-strategic alliance-market expansion" is formed, with an annual growth rate of cooperative institutions reaching 20%.

4.3.2 Strategic contention for the right to set standards

Standard embedding of patent portfolio: strategically submit proprietary technology patents (such as medical image compression algorithm) to industry standard organizations, making them the optional solution for international standards such as DICOM. An enterprise has entered the CT equipment standard system through 5 core patents, and the annual patent fee is over 30 million yuan.

Promoting network of alliance standards: Establishing technology promotion alliances with upstream and downstream enterprises to accelerate the penetration of standards through multiple channels such as clinical demonstration and continuing education. In DRGs payment reform, the cost accounting standards for diseases led by leading hospitals have become a reference template for many medical insurance bureaus.

5.Conclusions

This study explores the impact of the synergy between strategic innovation and technological progress in the healthcare industry on organizational performance, revealing the dynamic interaction patterns and practical value between them. The research indicates that strategic innovation guides technological progress and provides resources, while technological progress offers means and efficiency support for strategic innovation. Their synergy significantly enhances performance. The study constructs a "strategy-technology-performance" framework, emphasizing the characteristic of "dynamic equilibrium under regulatory constraints" in the synergy mechanism of the healthcare industry, which requires maintaining strategic foresight and ensuring the robustness of technology application. In practice, effective synergy mechanisms enhance performance by accelerating the conversion of R&D results, optimizing resource allocation, and strengthening brand influence. The study also highlights the moderating role of policy environment and organizational culture in the synergy effect. For healthcare institutions, the study recommends avoiding extreme tendencies in digital transformation, establishing a calibration mechanism between technology roadmaps and strategic planning, and making forward-looking layouts in frontier areas. Future research can explore differentiated paths for building synergy mechanisms in different healthcare institutions and integration models of international technology cooperation with local strategic innovation. This study provides a theoretical and practical framework for the healthcare industry to overcome the "innovation island" dilemma.

Funding

no

Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

Reference

[1] Li, Y. (2016). Research on the graduate training mechanism based on the collaborative innovation center for medical device industry, education, and research. Southern Medical University.

[2] Zhou, W. (2013). Research on the construction of performance evaluation system in public hospitals in China. Foreign Economic Relations and Trade, (4), 152-154.

[3] Chen, R. (2012). Performance evaluation of Chinese healthcare management organizations based on key success factors. Chongqing University.

[4] Song, P., Zhang, J., Li, T. Y., et al. (2010). Constructing an organizational performance evaluation model to enhance the connotation management of public hospitals. Chongqing Medical Journal, 39(20), 2825-2827.

[5] Wang, S., Wang, H. S., & Wang, Y. G. (2010). Analysis of the dynamic mechanism of regional collaborative systems for optimizing medical resource allocation. Science and Technology Management Research, 30(13), 270-275.

[6] Wang, S., Wang, H. S., & Wang, Y. G. (2009). Research on regional collaborative medical information system and collaborative model based on synergetics principle. Chinese Hospital Management, 29(7), 31-34.

[7] Zhou, Q. (2001). Selection of technology progress strategy model. Journal of Harbin Institute of Technology (Social Sciences Edition), (4), 53-57.

[8] Guo, J. H., & Wan, J. K. (1998). Strategic choice of technological innovation in China's pharmaceutical industry. Science and Technology Progress and Countermeasures, (5), 50-51.