DOI 10.3868/s070-008-023-0021-3

The Evolution of Innovation Mode for Technology-Based Small and Medium-Sized Enterprises under the Synergy of Opportunity Identification and Ambidextrous Strategic Combination*

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Abstract Taking Company M as the research object, this study adopts a case study method to explore the evolution of enterprise competitive advantage differentiation matching and resource-focused action in the iterative innovation process under the synergy of opportunity identification and ambidextrous strategic combination. This study reveals the formation mechanism and path of iterative innovation in enterprises, finding that opportunity identification is a dynamic and complex process with significant variations. Enterprises can creatively utilize the synergy between ambidextrous strategic combinations based on the identified opportunities to stimulate differentiated allocation of competitive advantage modules based on resource heterogeneity and incomplete factor-mobility, and to achieve strategic flexibility. The adaptive interaction between opportunity identification and ambidextrous strategic combination drives the staged evolution of resource-focused action, including resource bricolage, arrangement, and orchestration, thereby realizing the iterative innovation process of "technology exploration-based development model–market expansion-based development model–collaborative innovation-based development model."

Keywords opportunity identification, ambidextrous strategic combination, resource-focused action, iterative innovation

1 Introduction

In a dynamic and complex environment, the development of enterprises is highly constrained by limited resources and environmental dependencies. Moreover, the normalization of uncertainty makes it difficult to sustain traditional innovation models and prompts enterprises to adopt an iterative approach in their business development models. The iterative innovation of business development models has gained increasing attention in the academic community.

Resource-based theory argues that the collection of resources possessed by an enterprise is the source of its competitive

* This paper is translated from *Chinese Journal of Management* (管理学报), 2021, (6), 873–883.

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advantage, especially heterogeneous resources (Wakelin, 2001). This primarily manifests in two capabilities: opportunity identification and resource integration. The successful utilization of opportunities is closely related to rational resource allocation (Alexander et al., 2003; Gao & Ye, 2017). Scholars believe that strategic orientation in the process of enterprise development can leverage existing resources and explore new resources to overcome resource constraints, thus significantly impacting resource integration, competitive advantage building, and innovation performance. Moreover, resource-based theory fails to explain the dynamic process of how the acquisition of heterogeneous resources translate into enterprise innovation performance. The perspective of resource-focused action provides a valuable exploration of how enterprises focus on organizing resource collections to achieve organizational behaviors and adaptive interactions with resource contexts (Su et al., 2017). Opportunity identification and resource integration embody resource value heterogeneity and further become the core capabilities for enterprises to build competitive advantages (Sharon & Lowell, 2003). Meanwhile, the resource endowment and environmental constraints faced by enterprises at different stages of development are contextual, making the realization of resource value dependent not only on the attributes of the resources themselves but also on resource utilization, i.e., resource-focused action. Therefore, the foundation of differentiating competitive advantage building lies in opportunity identification, strategic orientation, and resource-focused action, which transforms heterogeneous resources into organizational innovation performance. The adaptive interaction of opportunity identification, strategic orientation, and resource-focused action within different resource contexts can lead to multiple iterations of enterprise development models, ultimately resulting in a nonlinear iterative innovation process.

Although numerous explorations of the interrelationships among the aforementioned factors have been made, there are still some shortcomings. (1) Relevant studies are rather independent. However, there is a lack of the systematic research on the intrinsic mechanisms of enterprise iterative innovation based on the synergy of opportunity identification and strategic orientation, as well as the selection of enterprise resource-focused actions. (2) Extant research tends to categorize strategic orientation into four types: market (technology) exploration and market (technology) exploitation. However, it fails to consider the interaction and ambidextrous combinations of these four types of strategic orientation in the innovation development process, which leads to differentiated innovation patterns. (3) Previous strategic research has focused on analyzing the results of strategic orientation choices on enterprise competitive advantage and innovation performance. However, there is a lack of micro-level analysis of the differentiated configuration and evolution processes among multiple competitive advantages.

In summary, this study takes M Medical Technology Co., Ltd. (Company M) as an example to explore the following two

research questions: (1) How do technology-based small and medium-sized enterprises (SMEs) develop differentiated competitive advantage and resource-focused action evolution through the synergistic matching of opportunity identification and ambidextrous strategic combination under different resource constraint situations? (2) How does this evolutionary and progressive process promote the iterative innovation process of business development models? This study aims to provide new explanations for technology-based SMEs to adopt effective resource allocation behaviors based on their resource contexts through opportunity identification and ambidextrous strategic combination, and to promote iterative innovation in enterprises.

2 Literature Review

2.1 | Opportunity Identification

Extant research suggests that opportunity identification, evaluation, and utilization are organically unified in the process of opportunity development, with opportunity identification being the most essential entrepreneurial behavior (Shane & Venkataraman, 2000). Opportunities arise from the perception and creativity of entrepreneurial behavior and represent the supply-demand gap in an unbalanced market (Hohenthal et al., 2003). Different research fields have explored the types of "opportunities" in the context of enterprise opportunity behavior. For example, the Opportunity Window Theory proposes three dimensions: technology, demand, and institutional framework (Wu et al., 2019). Researchers in entrepreneurial behavior, starting from the origin of opportunities, believe that technology and the market are the main aspects of opportunity activities (Wang et al., 2017). Drawing on relevant research, this study believes that opportunity identification includes efficiency-seeking arbitrage opportunities and technology breakthrough innovation opportunities. Arbitrage opportunities are based on capturing developmental space in an unbalanced market, while innovation opportunities rely on creating new market imbalances with competitive novelty value (Mainela et al., 2014).

The innovation development process of an enterprise is essentially a systematic and dynamic interaction between opportunities and resources. High alertness to opportunity identification enables enterprises to quickly identify development opportunities and allocate existing resources to achieve effective integration of opportunity development and resource development. Furthermore, there is diversity and differentiation in resource endowment, organizational environment, political institutions, etc., at different stages of enterprise development (Xu & Shan, 2019). Therefore, the relationship between opportunity identification and resource behavior in the enterprise development process is not a simple linear one.

2.2 | Ambidextrous Strategic Combination

In the context of transitioning economies, Chinese enterprises face multiple contradictory factors, and their innovation

development process often exhibits ambidextrous characteristics (Prange, 2012). Ambidexterity generally refers to the behavior of simultaneously exploring and exploiting within an organization (March, 1991), or the behavior of pursuing two different or even contradictory goals. The contradictory nature inherent in ambidextrous innovation behavior mainly manifests as the differentiation between exploration (acquiring new resources) and exploitation (improving the efficiency of existing resources), resulting in irreconcilable conflicts (March, 1991; Wu et al., 2016). Therefore, ambidextrous innovation is often difficult to achieve. However, some scholars argue that ambidextrous innovation can be transformed into the integration and complementarity of two different strategies, providing more growth opportunities and maintaining development stability (Luo & Rui, 2009). Among them, some scholars have studied the impact of four innovation strategies (technology exploration, technology exploitation, market exploration, and market exploitation) on the building of competitive advantages and the acquisition of innovation performance based on the perspective of ambidextrous innovation. In addition to exploring the coupling between utilization, market, and technology domains, ambidexterity should also include cross-domain ambidextrous combinations (O'Cass et al., 2014). Based on this, Xue (2019) further expands on the four innovation strategies mentioned above and proposes six possible ambidextrous combination strategies: single exploration, single exploitation, technological ambidexterity, market ambidexterity, technological development, and market development. Therefore, this study draws inspiration from his viewpoint and, based on the existing coupling of "technology (market)—exploration (exploitation)" and the idea of cross-domain ambidextrous combinations, believes that enterprises have the clear learning motivation and innovative practices in their development process for ambidextrous combination strategy.

In summary, the significance of resources for the innovative development of enterprises is self-evident. The traditional resource-based view suggests that the acquisition and development of heterogeneous resources based on opportunity identification and resource integration are the core foundation for building new advantages. It further proposes the basic ways to build competitive advantages: resource heterogeneity, pre-competition constraints, incomplete factor-mobility, and post-competition constraints (Liang et al., 2013). The choice of ambidextrous strategic combination embodies an enterprise's strategies for opportunity development and resource allocation. Therefore, it can be considered that the ways to build competitive advantages under the synergy of opportunity identification and ambidextrous strategic combination also include the aforementioned four strategies.

2.3 | Resource Behavior

The resource-based view argues that heterogeneous resources, formed based on the differences in the aggregation of resources, are the core source of an enterprise's competitive advantage

(Wakelin, 2001). However, it mainly explores the relationship between the characteristics of resources and competitive advantage from a static resource perspective and fails to explain the dynamic evolution process from resource acquisition to utilization. As a result, Baker et al. (2003) have proposed the concept of "resource bricolage" some scholars from the perspective of bricolage, suggesting that resource bricolage is one of the important avenues for entrepreneurs to overcome resource constraints (Zhao et al., 2016).

As enterprises develop, the complexity and uncertainty of resource endowments and organizational contexts make the resource "bricolage" behavior in the early stages lose coherence and reliability, making it difficult to maintain the effective operation of the resource system. In response, some scholars have combined the resource-based theory with research on dynamic capabilities, further proposing the concept of "resource orchestration" (Sirmon & Hitt, 2009). They emphasize the dynamic management of resources to achieve the dynamic development of transforming resources into capabilities and gaining competitive advantage (Sirmon et al., 2011). Scholars believe that, along with the development process of enterprises, resource behaviors undergo a staged evolution of resource bricolage, arrangement, and orchestration (Su et al., 2017). Extant research mainly explores the influencing factors of resource behavior and its impact on organizational performance and innovation capabilities, overlooking the possible evolution process of resource-focused actions during the dynamic development of resource contexts.

2.4 | Iterative Innovation

Extant research suggests that iterative innovation is an important innovation strategy in the Internet era to cope with dynamic and complex competitive environments. The normalization of uncertainty prompts innovation models to shift towards rapid iteration and incremental adjustments (Kiefer et al., 2012). Some scholars argue that iterative innovation is a process of commercializing creative inventions and continuously adjusting and revising them based on market feedback through iterations (Fitzgerald et al., 2010). By utilizing existing technological achievements, deeply exploring and closely tracking potential customer needs, and launching market-recognized products and services, iterative innovation achieves functional upgrades or technological innovations in each iteration, and even ultimately achieves disruptive effects (Luo et al., 2014).

As research deepens, domestic studies have gradually extended to the characteristics, process mechanisms, and organizational requirements of iterative innovation. Zhang and Wang (2016) believe that, unlike traditional innovation models characterized by stability and predictability, iterative innovation presents two fundamental dimensions: interactivity and proactiveness. The realization of interactivity and proactiveness relies on three key mechanisms: user interaction, rapid response, and cross-domain integration. In addition, iterative innovation also poses new requirements for organizational culture, capabilities, and structures. To meet the development needs of iterative innovation,

organizations need not only the corresponding innovation research and development capabilities but also strong capabilities in user interaction, opportunity identification, resource integration, and cross-domain learning. They need to identify development opportunities through user interactions, learn from the external environment to acquire new technologies and solutions, respond to user needs, and adjust and iterate products accordingly. The corresponding organizational structure should have characteristics of blurred boundaries, flattened structure, and team-based organization. Therefore, iterative innovation is also a nonlinear process of organizational learning and evolution (Zhang & Zhang, 2017).

Early research on iterative innovation primarily focused on the product development level, known as "iterative development." Subsequently, research on iterative innovation gradually shifted and expanded to include product and technological innovation, and even business development model innovation. In this study, iterative innovation mainly refers to the innovation of business development models. The iterative innovation process is described as organizations responding to dynamic and complex organizational environments through opportunity identification, strategic adjustments, and adaptive interactions of resource behaviors. This process facilitates the effectiveness of three mechanisms: user interaction, rapid response, and cross-domain integration. It is accompanied by the shaping of organizational culture, capabilities, and structure through organizational learning. Ultimately, it leads to the enhancement of organizational innovation capabilities, competitive advantages, and the gradual iterative improvement of business development models.

Based on the above, it can be summed up that there is a close inherent connection between opportunity identification, ambidextrous strategic combination, resource behaviors, and iterative innovation. Thus, this study proposes the following basic concept model (see Figure 1).

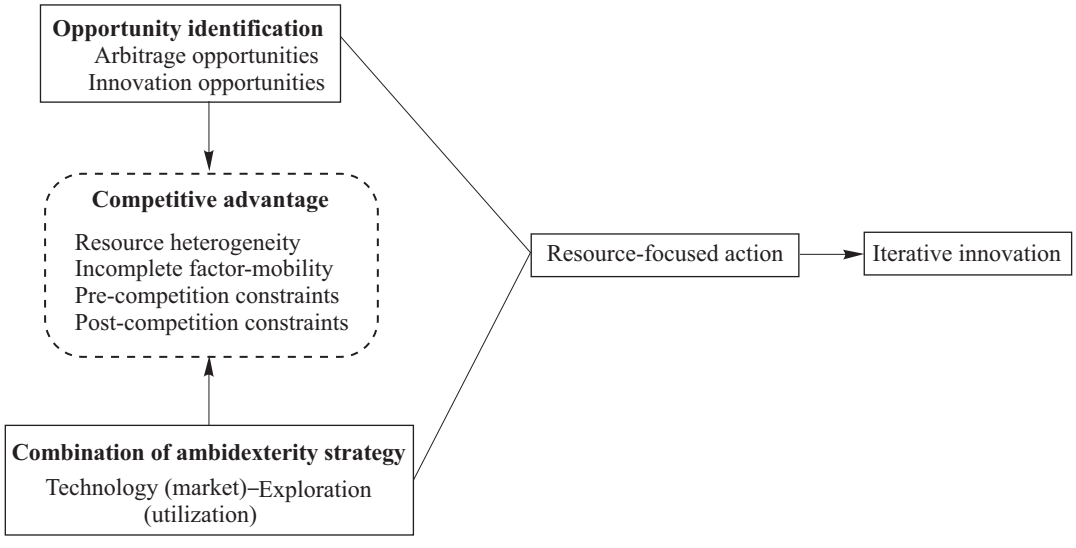

Figure 1 Basic Concept Model

3 Research Design and Case Introduction

3.1 | Research Method

Yin (2014) argues that case study is one of the important empirical research methods in social science research, which can analyze and explain the causes, processes, and outcomes of decisions through specific cases, thereby revealing the underlying logical relationships behind phenomena. This study focuses on exploring the resource-focused action evolution process and iterative innovation formation mechanism of technology-based SMEs based on opportunity identification and ambidextrous strategic combination, which require detailed and quantitative data. A typical single case study can form a chain of key event evidence and delve into the underlying causal relationships and theoretical logic, making it suitable for studying "what" and "how" type of questions. Therefore, this study adopts a single case study method.

3.2 | Case Selection

Eisenhardt (1989) points out that representativeness is the primary principle for selecting case studies. In this study, Company M is chosen as the case study object for the following reasons: Firstly, Company M is a technology-based SME and the first in China to introduce 3D bio-printing technology into medical devices. It has developed the core product "RD" using bio-additive manufacturing technology, making it one of the nine "internationally original" products listed in the *Innovation Medical Device Product Catalog (2018)* by China's Ministry of Science and Technology. Currently, it has obtained registration for four Class Ⅲ and one Class Ⅱ medical device products, and filed for one Class Ⅰ medical device product. It has obtained CE certificates and CE Design certificates for three products and has nine products under research. The company has been granted 134 domestic and foreign patents, including 61 invention patents, forming a rich patent layout and diversified product line.

Moreover, the core product represented by "RD" is in a stage of rapid growth and has gradually transformed into the company's economic performance. In 2019, the revenue of core technology products accounted for 98% of the main business income. The products have serviced more than 600 domestic hospitals and over 70 countries and regions in the international market, with clinical applications exceeding 200,000 cases. The company has become one of the few domestic manufacturers capable of exporting high-end medical devices to overseas markets on a large scale, and it holds a leading position in the field of neurosurgery in terms of product layout, technological patent reserves, and product innovation.

Secondly, in the dynamic and complex organizational environment, the company can adopt ambidextrous strategic combination and resource-focused action based on opportunity identification, effectively resolving resource constraints on organizational capabilities, and achieving improvements in core competitiveness and iterative innovation in development

models. Based on a deep understanding of technology trends, domestic market demand, policy environment, and other diverse opportunities, the company focuses on combining different resources at different stages. It drives product performance and structural iteration and upgrading with "technology innovation" as the driving force and "clinical demand" as the guidance. It follows a product development strategy of "pre-research generation, development generation, and sales generation," and promotes the product's performance and structural iteration and upgrading. Additionally, the company improves its marketing network system and enhances its industrial transformation capabilities, thereby achieving industry-leading technological advantages and market position. Its development process presents a dynamic process of opportunity identification, ambidextrous strategic combination, and resource-focused action in the iterative innovation process of the company.

Lastly, sufficient data are also an important principle for selecting case study objects. Company M has abundant publicly available information, and the research team has conducted long-term on-site research on the company. Regular field visits and investigations make it easy to obtain real-time relevant information.

3.3 | Data Collection and Analysis

In this study, a "triangulation" relationship is formed through multiple data sources to establish a database and evidence chain for the case, aiming to improve the credibility and validity of the research (Yin, 2014). The main sources of data include: (1) semi-structured interviews with the management team, technical personnel, and frontline employees of Company M; (2) company data such as the official website, financial reports, and industry public data; and (3) relevant media reports, comments, and domestic and foreign research literature about Company M.

The data of this study were collected in three stages. (1) extensive collection of internal and external information about the company, which was used to preliminarily outline the development process and key events sequence of Company M, and to prepare interview guidelines accordingly. (2) From July 2018 to December 2018, tracking research and on-site observations were conducted on Company M. Semi-structured interviews over 60 minutes were conducted with senior executives, technical researchers, and frontline employees. The interview recordings were transcribed into written transcripts within 24 hours after the interviews. (3) All data materials were integrated and coded. During this process, close contact was maintained with the interviewees to confirm and supplement information.

3.4 | Case Description

The analysis of Company M development process shows that the company has gone through the following stages of development.

3.4.1 *Start-Up Stage: Deepening the Development of Core Technology in Bio-Additive Manufacturing*

The founder of the company studied abroad and returned to China to establish the

country's first national high-tech enterprise that applies 3D bioprinting technology to manufacture medical devices. Initially, he had limited resources. Leveraging his expertise and research achievements accumulated during his study abroad, as well as government support and other resources, the company identified the development prospects and market demand of bio-additive manufacturing technology. It pooled resources on the development of core technology and became the first in China to develop a core product, the artificial dura mater patch "RD," and established their global intellectual property protection system, which laid the foundation for them to focus on technology exploration and knowledge accumulation based on market demand exploration.

3.4.2 *Growth Stage: Focusing on Industrial Transformation and Technological Expansion and Achieving Iterative Upgrades of Core Products*

The company built a global marketing system with product registration, promotion, sales, and after-sales service as its core. Based on the research accumulation of core technology, the company independently developed and built an industrialization platform to overcome challenges such as the lack of mature industrial equipment and experience reference. This platform ensured the large-scale production of products. In addition, technological innovations were utilized to upgrade the performance of core products. The product "RD" obtained the CE certification in the EU, medical device registration certificates in China, and registration certificates in India, continuously meeting the demands of new markets and improving technological universality. Furthermore, based on the research and development experience of the product "RD," a new generation of dura mater patch product "ND" was developed, which, together with "RD," provided a comprehensive solution for brain membrane repair surgery. During this period, the company's technological advantages gradually emerged and transformed into a driving force for market expansion. The coordinated advancement of iterative upgrades of core products and industrial transformation was achieved, and the strategic focus shifted from technology exploration to market development.

3.4.3 *Renewal Stage: Broadening Innovation Platforms, Extending Application Fields, and Focusing on Interdisciplinary Product Development*

Facing multiple opportunities such as policy dividends, market imbalances, and diversified demands, Company M has established a talent mobility mechanism to promote deep integration of industries, universities, research institutes, and hospitals, as well as industrial collaborative innovation. It has successively joined the "China Additive Manufacturing Industry Alliance" and the "Guangdong 3D Printing Industry Innovation Alliance." Based on existing technological reserves and guided by clinical needs, Company M aims to gradually establish advanced manufacturing technology platforms such as digital design and precision processing. It seeks to expand the application of existing core technologies in fields such as oral and maxillofacial

surgery and neurosurgery. The company plans to develop a diverse product portfolio, including "RL" and customized orthodontic appliances such as oral absorbable repair membranes "RT" and "HM." It will also focus on promoting product and technological iteration and upgrading to enhance product synergy. Company M aims to redirect its innovation activities towards technology exploration and effectively support all stages of the innovation chain. It will foster synergy between front-end research and development and back-end industrialization, resulting in a development pattern driven by both technology exploration and market utilization. The development stages of Company M are outlined in Table 1.

Table 1 Company M Development Stages

Category	Start-up stage	Growth stage	Renewal stage
Background	Two founders were leading figures in regenerative medicine, decided to return to China upon completion of their study overseas, as this academic discipline was almost empty in China then	Vast domestic and international markets	Multiple opportunities: policy dividends; imbalanced market; diversified demand
Disposable resources	Challenges for founders: limited resources; talent loss; shortage of capital	Extensive and arduous product R&D, as well as technological accumulation in the start-up stage, has contributed to the enterprise's disposable resources	Accumulated technological expertise and market resources from start-up stage efforts
Key event	Success in developing their core product "RD" Success in establishing their own comprehensive intellectual property system	Independent R&D industrialization platform established Subsidiaries in the US, Germany, and Shenzhen; developing internationally advanced industrialization bases Core products has entered domestic and international markets, and iteratively developed related products	Establishing a mechanism for talent mobility Joining organizations such as the "China Additive Manufacturing Sector Alliance" and the "Guang dong Province 3D Printing Sector Innovation Alliance" Launching various products for specific niche markets
Key product	1st-generation artificial dura (spinal) membrane patch "RD"	Artificial meningeal patch series "RD" + "ND"	Cross-departmental product lines for customized correction devices: "RL," "RT," and "HM"
Features	Working hard; Policy support; Building up core technological systems	Technological advantages to drive market expansion	Deep integration of industries, universities, research institutes, and hospitals; collaborative innovation in industries; collaborative promotion of technology R&D and industrialization
Business focus	Based on market demand, exploring technological innovation and conducting knowledge accumulation	Shifting from technology exploration to market expansion	Double driver of technology exploration and market utilization

4 Case Analysis

4.1 | Start-Up Stage: Formation Mechanism of Technology Exploration Development Model

4.1.1 *Technology Exploration Development Model and Building Competitive Advantage*

At the beginning of its establishment, Company M observed the rapid development of international 3D bioprinting technology, with developed countries in Europe and America intensifying their efforts to seize the advantages of the new technology wave by laying out the 3D bioprinting industry. Meanwhile, the field of regenerative medicine in China was almost blank, with over 90% of the products relying on imports. The imbalance in the market created the basis for arbitrage opportunities. The vast market demand in China and the underutilized resources in the related fields were first identified and captured by the company's founders. In response, the company adopted an ambidextrous strategy of technology exploration and market exploration, combining its heterogeneous resource endowments to seek effective integration with the target market demand. This allowed the company to leverage arbitrage opportunities in the domestic market.

(1) *Utilizing the unique resource endowments of the company to build a core technological resource system with high industry barriers, seizing the opportunity to occupy a leading position in the industry under technological constraints*. Special heterogeneous resources are the source of a company's competitive advantage. The technical advantages and industry experience embodied by the technical research and development team, represented by the founders, are the cornerstone of the company's survival and development. This allows the start-up company to have a considerable level of research accumulation and technological reserves, occupying a significant advantage in the industry. Through establishing industry-leading advantages in the development of entrepreneurial opportunities, the company builds pre-competition constraints. Moreover, the sustainability of a company's competitive advantage highly depends on the non-imitability of its resources. The company increases the imitation cost of its core technology by establishing and improving intellectual property protection system, building isolation mechanism and mobile barriers based on key resources, and forming effective post-competition constraints based on entrepreneurial entry barriers.

(2) *Looking at the weak aspects in the target market and the industry's development trends, exploring potential market growth poles and industrial technology transfer*. Company M keenly recognized that excellent biomaterials were the key technology to break through in tissue repair industry and to change the current situation where domestic animal-derived tissue repair products faced difficulties in entering the international market. The company started developing its first artificial dura mater (spinal) patch, "RD," and obtained relevant licenses for medical device production and market access qualifications in Guangdong Province. During this period, based on the

strategic goal of building core technological advantages and exploring potential target markets, the company established an ambidextrous strategy combination of technology exploration and market exploration. It focused on innovating the resource system of core technology and preparing resources for market entry, forming a technology exploration development model mainly based on pre-competition constraints and post-competition constraints.

4.1.2 *Basic Characteristics of Resource Bricolage Action*

In the very beginning, Company M faced limitations in resources and capabilities. It primarily relied on the founder's ability to perceive and identify opportunities, on the team's strong scientific research capabilities, and on the governmental support to provide resources for technological innovation within the organization. Benefiting from the favorable policy environment and support from the local government, which is committed to reform, openness, and innovation, the company successfully navigated the initial stage of technology exploration, which involved significant investment, a long cycle, and high risks. This allowed for the integration of technology with financial and industrial capital.

However, due to limited resource availability, the company could only focus on a few technology projects centered around "RD" based on opportunity identification to effectively meet market demand. This identification of arbitrage opportunities and the adoption of a single exploration strategy prompted the company to allocate its limited resources effectively, leading to resource bricolage action characterized by simple allocation of limited resources. The formation mechanism of technology exploration development model under resource bricolage is illustrated in Figure 2.

4.2 | Growth Stage: Mechanism for the Formation of Market Development Model

4.2.1 *Market Development Model and Competitive Advantage Growth*

In the growth stage, Company M mainly relied on a high level of awareness of international market environment and industrial technology to identify opportunities. At that time, the products developed by international medical device industry giants still used traditional materials or processing methods, resulting in limited repair effects and slow industrialization progress of 3D bioprinting technology. The combination of imbalanced domestic and foreign markets provided deeper arbitrage opportunities for the innovative development of Company M. Based on the precise targeting of the previous core technology resources and market demand, Company M quickly launched independently developed products to rapidly respond to a broad market demand, establishing an ambidextrous strategy that combines technology utilization and market utilization.

In terms of technology utilization, the company's previous technological achievements entered the fast track of industrialization one after another.

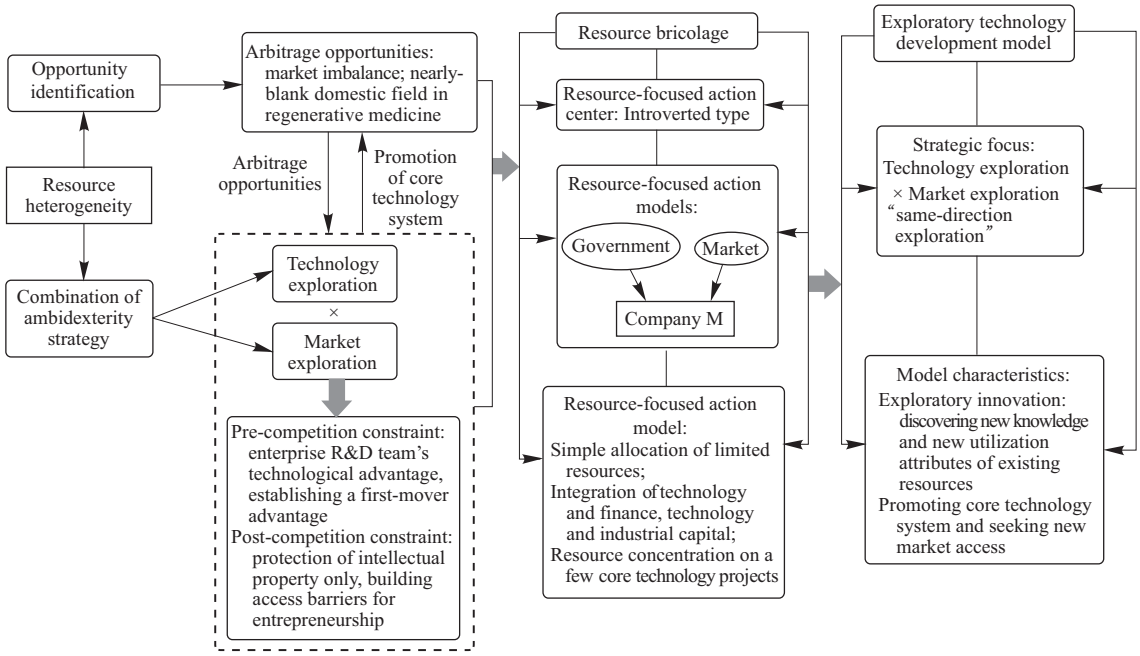

Figure 2 The Formation Mechanism of Technology Exploration Development Model under the Resource Bricolage

Core products represented by "RD" and "ND" successfully obtained authoritative certifications domestically and internationally, quickly entering the international market. This achieved the first industrialization of 3D bioprinting technology on a global scale, earning the company reputation and industry influence. Additionally, existing innovation assets were actively utilized to explore channels for resource acquisition. On one hand, rooted in the entrepreneurial spirit of the company's founder, it further developed and solidified into the company's 3C culture (care, creativity, cooperation). The company's innovation culture became a bundled asset for technology, enriching and deepening the company's knowledge management methods. On the other hand, through collaborative innovation between industries, universities, and research institutes, the company established a provincial postdoctoral innovation practice base, utilizing long-term technological and talent capital investments to lay the foundation for the next stage of technology exploration. The innovation factors built on the foundation of knowledge management and organizational learning were not completely fluid, further strengthening the company's competitive advantage.

In terms of market utilization, rapid expansion and steady industrialization were achieved under the strategy of market globalization. By obtaining international certifications for new products and establishing internationally advanced industrial base, Company M conducted professional marketing and provided technical support to global customers. Taking "RD" as an example, it successfully entered top-notch major hospitals in Europe, with a market share exceeding 50% in some countries. In this process, it quickly gained market share, gained brand recognition and competitive advantages, accumulated and utilized partner resources and customer resources, and provided benefits and revenue for their own sustainable development. This collection

and accumulation of resources then transformed into pre-rental occupancy of future entrepreneurial opportunities, becoming an important way for the company to build post-competition constraints. In this stage, Company M, with the strategic goal of market globalization, combined in-depth innovation assets with broad customer assets, forming a value acquisition model of global market development and occupation supported by the company's research and development capabilities. Therefore, it embodies a market development model that combines incomplete factor-mobility and post-competition constraints as competitive advantage.

4.2.2 *Basic Characteristics of Resource Bricolage Action*

During the growth stage, Company M utilizes its core technological resources to build its core competitive advantage. With the strategic goal of market globalization, it gradually expands its market share, thus completing the strategic shift from exploring technology-market assets in the same direction to utilizing them in the same direction. This results in a single utilization strategy characterized by the utilization of technology and market resources. Additionally, the focus of resource-focused actions shifts from being "internal-based approach" in the start-up stage to being "external-based approach." During the start-up stage, due to resource limitations, the focus of resource allocation is on combining external financial capital with enterprise technological capital to sustain the survival and development of the company. During the growth stage, the stock of resources and the level of capabilities of the company continue to increase, which reduces the dependence on external resources under resource constraints. The company begins to acquire and invest in external resources based on market development and industry-university-research institute cooperation, gradually expanding the collection of heterogeneous resources of the company. The resource-focused action mode is characterized by resource arrangement based mainly on industry-university-research institute cooperation, integration and allocation of relevant resources, and on industrial scaling. For the formation mechanism of the market expansion development model under resource arrangement, please see Figure 3.

4.3 | Renewal Stage: Mechanism of Collaborative Innovation Development Model

4.3.1 *Collaborative Innovation Development Model and Building Competitive Advantage*

During this stage, arbitrage opportunities and innovation opportunities overlap and intertwine with each other. Based on the understanding of the national institutional framework, arbitrage opportunities brought by policy dividends and institutional incentives are explored. Strategic emerging industries, such as biomedicine, have become new pillars of the industrial sector in Guangdong. The *13th Five-Year Plan for Medical Device Technological Innovation* proposes to "innovate the catalog of medical device products and create a batch of domestically innovative brands." It also encourages and supports private enterprises

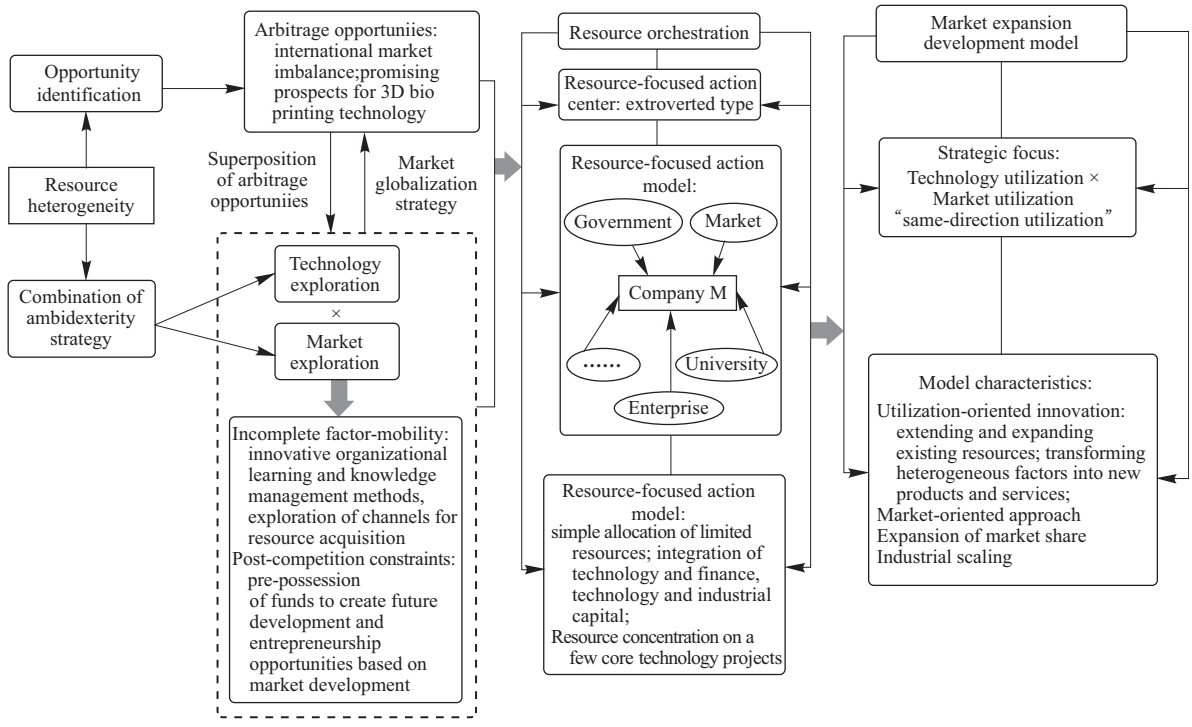

Figure 3 The Formation Mechanism of Market Expansion Development Model under Resource Arrangement

to participate in major national scientific and technological programs. The convergence of these significant opportunities brings about more spillover effects and development opportunities. Moreover, the identification of innovation opportunities based on deep insights into the diversified demands of different target customers also places higher requirements on enterprises' technological innovation. How to explore the path of technological innovation under diversified demands based on a broad customer market network becomes the strategic orientation of the renewal stage for enterprises. This establishes an ambidextrous strategy of combining technology exploration with market utilization. The main manifestations include:

(1) *Establishing a talent mobility mechanism to promote deep integration of industries, universities, research institutes, and hospitals*. Guangdong Province has the largest scale of biomaterials and medical device industry and market in China, with a strong leading industry and abundant clinical resources. Company M relies on the local industrial chain and market scale advantages and collaborates with scientific research institutes, universities, hospitals, and enterprises in various regions through independent research and development platforms and post-doctorate workstations. It promotes the reorganization and optimization of talent team functions, further innovates organizational learning methods, and explores the disruptive incomplete factor-mobility from "industry-university-research institute" to "industry-university-research-hospital."

(2) *Utilizing high industry correlations to build a collaborative innovation network and enhance the ability of opportunity identification and development based on diversified factor cohesion and complementarity.* 3D bioprinting technology in the field of biomedicine is highly correlated with a large number of medical and healthcare industries, including regenerative medicine,

medical devices, and drug development. It is a necessary technological foundation for promoting the transformation and upgrading of these industries. Company M uses industry alliances as a platform to gradually integrate innovative resources from diverse entities, such as domestic and foreign universities, clinical services, scientific research institutes, and enterprises, to promote key, shared, and frontier technological development in the field of 3D bioprinting. The collaborative innovation network formed by the allocation of industrial resources based on breadth, through collaborative innovation and open sharing, provides diverse technological combination and resource complementarity for the identification and development of innovative opportunities, enhances the ability of enterprises to develop opportunities, and builds a new round of post-competition constraints.

(3) *Relying on a collaborative and open resource network, focusing on identifying differentiated demands as the innovation focus, and exploring the development path from a single market to a diversified market*. 3D bioprinting technology in the field of biomedicine has strong penetrability and wide applicability. It integrates and permeates with other industries at an accelerated pace and has a broad and increasingly diversified and personalized market demand. Thus, Company M effectively explores the asymmetry between traditional products and emerging market consumer demands based on a broad customer asset allocation and a deep resource platform. It transforms the potential value emerging in the market into product value-added sources. Company M starts focusing on innovation asset allocation based on potential needs of specific customers and develops innovative personalized custom products such as "RL," "PEEK," and "HM" customized orthodontic devices. This allows Company M to further expand its target market into areas such as neurosurgery and digital dentistry. By doing so, the company maintains a high level of competency in its core technology and identifies opportunities and diversifies its expansion based on market factors. This becomes an important weapon for Company M to sustain innovation and establish pre-competition constraints. During this stage, Company M accelerates cross-domain integration based on comprehensive opportunity accumulation. It leverages an industrial collaborative innovation network to facilitate shared openness and in-depth exploration of market demand. This leads to the formation of a collaborative innovation-based development model, which combines incomplete factor-mobility, pre-competition constraints, and post-competition constraints as a competitive advantage combination.

4.3.2 *Basic Characteristics of Resource Orchestration Action*

The institutional framework and policy dividends that focus on domestic industrial structural transformation and innovation-driven development provide relatively abundant resource stock and allocation space for enterprises' innovative development. However, based on the identification of entrepreneurial opportunities under high industry correlations, it requires enterprises to innovate their resource utilization methods and achieve precise alignment

between technological assets and customer assets. This forms an ambidextrous strategic combination of technology development. The strategic focus shifts from the same-directional utilization of technology-market to the penetration of technology into the market, and the focus of resource utilization moves from "expansion-based" approach to "sharing and open" approach. This means that in the growth stage, Company M serves as the core for technology and capital expansion, while in the renewal phase, the focus moves to a diverse network of collaborative innovation involving industries, universities, research institutes, and hospitals. This network gathers diverse factors such as technology, talent, and market from different innovation entities, and achieves open sharing and differentiated allocation through mechanism innovation. This drives enterprises to identify more forward-looking market demands and guide their technological innovation and outcome transformation. It is evident that this stage focuses on integrating the flow of factors, realizing collaborative innovation between diverse innovation entities and effectively identifying innovation opportunities. The resource-focused action mode is characterized by the flow mechanism of innovative factors, the deployment of innovative platforms, and the exploration of diverse demands as the main features of resource orchestration. The formation mechanism of collaborative innovation development model under resource orchestration is shown in Figure 4.

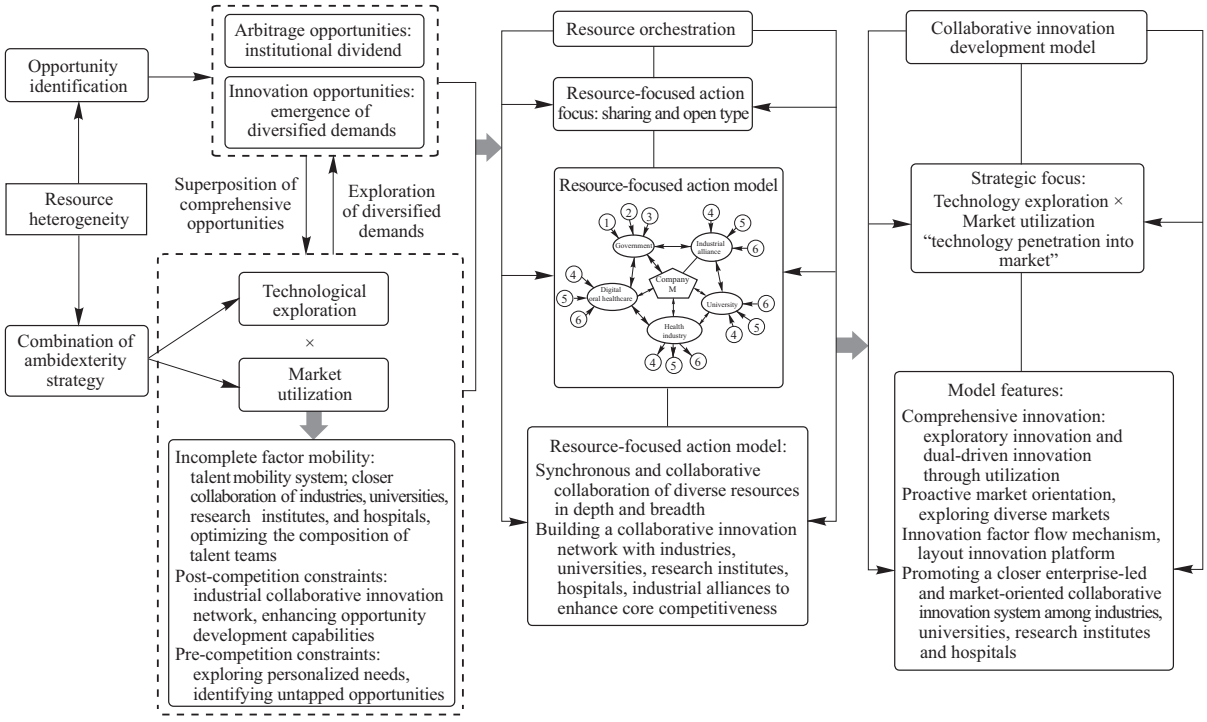

Figure 4 The Formation Mechanism of Collaborative Innovation Development Model under Resource Orchestration

4.4 | Development Path of Iterative Innovation

The case analysis suggests that Company M triggers three mechanisms of user interaction, rapid response, and cross-domain integration based on matching opportunities identified under different resource contexts and ambidextrous strategic combinations, and adopts corresponding resource-focused action modes to achieve iterative innovation of business development models.

Firstly, opportunity identification is a dynamic and complex process that presents significant differences, depending on the enterprise's unique resource endowments and highly complex institutional framework evaluations, arbitrage opportunities incubated by market imbalances and institutional framework dividends, and innovation opportunities driven by diversified market demands, prompting enterprises to transition from "overlapping arbitrage opportunities" to "coupling arbitrage opportunities and innovation opportunities." Demand-based opportunity identification maintains a high sensitivity to user needs and technology development trends, from personal experience perception to the building of international industrialization bases, and then to the deep integration of industries, universities, research institutes, and hospitals. Enterprises are committed to involving users from different regions and fields in the innovation process, achieving wide participation of innovation through iterative upgrading of the user interaction mechanism.

Secondly, the repeated weighing of market potential value and enterprise resource endowments drives the iterative upgrading of strategic choices, organizational capabilities, and resource allocation modes. Therefore, the selection of ambidextrous strategic combinations achieves the upgrade from a "single exploration strategy" to a "single exploitation strategy," and ultimately to a "technology development strategy." This is based on four ways: resource heterogeneity, pre-competition constraints, incomplete factor-mobility, and post-competition constraints, realizing the differentiated combination and evolution of enterprise strategic flexibility and competitive advantage (see Table 2). The synergy of opportunity identification and ambidextrous strategic combination influences the choice of enterprise resource-focused action modes for enterprises, shifting the strategic focus from a unidirectional exploration of technology-market alignment to a continuous shift towards technology utilization and penetration in the market. The resource-focused action mode also undergoes a deep development from an "internal-based" approach to an "external-based" approach, and finally to a "sharing and open" approach. These characteristics are manifested through simple resource bricolage, selective combination of related resources, and synergistic sharing of multiple resources. Ultimately, this leads to the evolution of resource-focused action process characterized by "bricolage-arrangement-orchestration." The iterative upgrading of the ambidextrous strategic combination and resource-focused action triggers the linkage between the rapid

Table 2 Typical Examples of Differentiated Combination and Evolution of Competitive Advantage Modules in Company M

Development Stage	Typical Example	Encoding Outcome	Module of Competitive Advantage
Start-up	Importing monopolized high-end implantable medical devices in China; returning to China after overseas studies to develop substitution products for China (A1); during the early stages of entrepreneurship, all the money was invested in research and development; willing to take risks through innovation rather than passively wait for failure (A1)	Arbitrage opportunity identification and development ability	Resource heterogeneity
	Having a high-level management and technical innovation team, including renowned scholars in regenerative medicine and experienced experts in industrialization (B3)	Creating a first-mover advantage in developing entrepreneurial opportunities	Pre-competition constraints
	Valuing the protection of intellectual property rights and owns a comprehensive global intellectual property protection system (B3)	Building barriers for access into this sector	Post-competition constraints
Growth	International giants in the medical device industry use traditional materials or processing methods, the product effect is limited, the price is high, and new innovative technologies are needed (B2); the market potential is huge, especially in China; China hopes to seize the opportunity of the country to vigorously develop 3D bioprinting and achieve production industry (A1)	Identifying and developing the ability to recognize arbitrage opportunities; integrating and utilizing resources to promote industrialization	Resource heterogeneity
	Needing many talented individuals proficient in translating basic research into industrial and market applications and in marketing them (A1)		
	Following the founders' academic culture of "freedom, openness, and innovation," the company has created its culture of 3C: care, creativity, and cooperation	Organizing an innovative culture; deepening knowledge management methods	Incomplete factor-mobility
	A postdoctoral innovation practice base set up with universities in Guangdong Province was recognized officially in 2012; establishing a postdoctoral research workstation in 2013 (B2)	Innovating organizational learning methods (industry-university-research institute collaboration)	
	"RD" marketable in over 60 countries and regions with over 50% market share in some countries; putting up a world-class industrialization base (B2)	"Preemptive rent" fordeveloping entrepreneurial opportunities	Post-competition constraints

(*To be continued*)

(*Continued*)

Development Stage	Typical Example	Encoding Outcome	Module of Competitive Advantage
Renewal	The strategic emerging industries, such as biomedicine, will become the new pillar of Guangdong Province's industrial system; the *13th Five-Year Plan for Medical Device Technological Innovation* calls for marketing innovative medical devices (B2) The integration of hospitals, universities, and research institutes essential to promote deep integration of industries, universities and research institutes in the biomedical and health industries (B2) Continued investment in original and cutting-edge technologies is crucial for sustained innovation. It is important to expedite the industrial transformation of original technologies and develop market-recognized products (A1)	Identification and development capabilities of opportunities for profit and innovation; innovative integration and utilization of resources	Resource heterogeneity
	The innovation team has attracted many doctors and postdocs from top domestic and foreign universities and domestic benchmark clinical units to join (B3) Building innovative practice platforms such as digital medical center and industrial research institute with several hospitals and units, attracting several key talents (B3)	Optimization of talent team's functional composition; innovation in organizational learning methods (integration of industries, universities, research institutes, and hospitals)	Incomplete factor-mobility
	3D bioprinting technology is highly related to a large number of medical and health industries, and is the necessary technical basis to promote the replacement and upgrading of these industries (B2); leading the biological additive manufacturing working group, integrating innovative resources of universities, clinical units, scientific research institutions, enterprises, etc., and collaborating on innovation (B2)	Establishing a collaborative innovation network; enhancing the ability to identify and develop entrepreneurial opportunities	Post-competition constraints
	"RL," a balance point found in the exploration of cranial bone repair, combining traditional and innovative approaches, with innovation in material selection and manufacturing methods (A1) The success of "HM" customized orthodontic appliances marking the company's move towards digital dental solutions (B2)	Diversification and expansion; identifying untapped opportunities	Pre-competition constraints

response mechanism and cross-domain integration mechanism, promoting resource integration and transforming heterogeneous resources into innovative performance. With the normalization of organizational environmental uncertainty and the enhancement of resource allocation capabilities, enterprises have an endogenous motivation to seek and expand resources externally.

From the hard work of entrepreneurial teams in the start-up stage, to the cooperation between industry, university, and research institute in the growth stage, and then to the deepening of the cooperation between industries, universities, research institutes, and hospitals in the renewal stage, the development of cross-domain integration mechanism is driving the open innovation of enterprises and laying the foundation for rapid resource integration. By combining technology micro-innovations, enterprises have successively launched multiple products to meet market demands. The integration and interaction of the three mechanisms promote interactive and forward-looking innovation in the enterprises' innovation and development process, shaping the organizational innovation culture, knowledge management methods, organizational learning methods, and capabilities, and promoting the overall

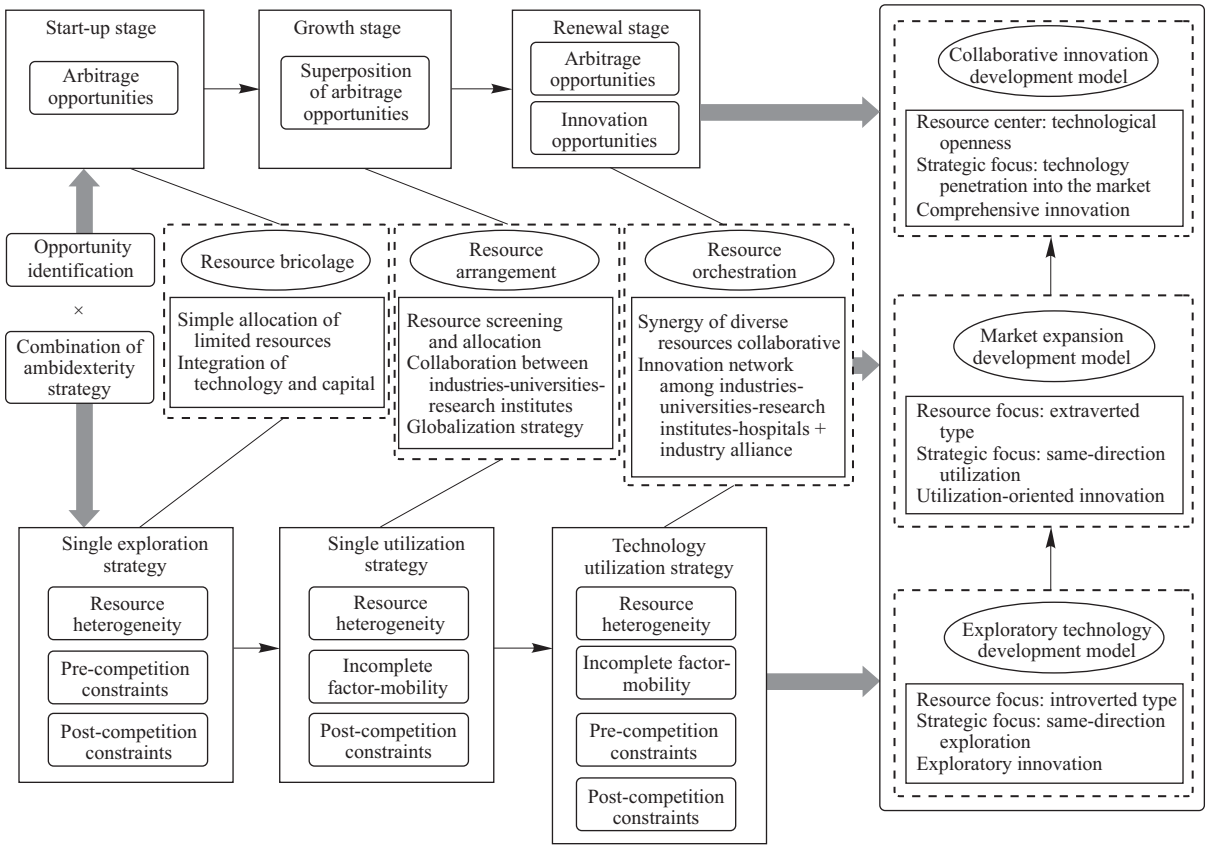

Figure 5 The Development Path of Iterative Innovation under Resource-Focused Action Evolution

improvement of organizational innovation research and development capabilities, user interaction capabilities, cross-domain learning, and resource integration capabilities.

Moreover, along with the evolution of enterprise resource-focused actions, the enterprise presents an iterative innovation process of "technology exploration-based development mode-market expansion-based development mode-collaborative innovation-based development mode." Specifically, driven by internal and external factors, the enterprise identifies opportunities and flexibly selects and couples resource-focused actions based on different organizational contexts and resource endowments at different stages, triggering user interaction, rapid response, cross-domain integration mechanism, and adjustments to organizational competitive advantages, resource boundaries, and organizational functions. Ultimately, an iterative innovation of the business development model is achieved. The development path of iterative innovation under resource-focused action evolution is shown in Figure 5.

5 Conclusions

Based on the above analysis, this study draws the following research conclusions.

(1) Effective opportunity identification and ambidextrous strategic combination are key factors for enterprises to build core competitiveness. Opportunity identification drives enterprises to focus on the synergy between multiple strategic orientations. Through highly differentiated and loosely coupled am bidextrous strategic combinations, enterprises explore single exploration, single exploitation, and technological development ambidextrous strategic combination. Based on resource heterogeneity, pre-competition constraints, incomplete factor-mobility, and post-competition constraints, different competitive advantage modules are flexibly configured to build the strategic flexibility of the enterprise.

(2) The synergistic matching of opportunity identification and ambidextrous strategic combination has promoted the deep development of the focus of enterprise resource-focused actions from "internal-based approach" to "external-based approach" and further to "sharing and open approach," as well as the progressive evolution of the enterprise resource-focused action pattern from "bricolage-arrangement-orchestration."

(3) The organic unity of opportunity identification, ambidextrous strategic combination, and resource-focused actions can trigger user interaction, rapid response, and cross-domain integration mechanisms, promote the progressive adjustment of organizational capabilities, resource allocation modes, and action patterns, thus leading to iterative innovation of the business development model and ultimately presenting an iterative innovation development path of "technology exploration-based development mode-market expansion-based development mode-collaborative innovation-based development mode." From a theoretical perspective, this study explores the characteristics of resource-focused actions and the formation path of iterative innovation under the synergistic

matching of opportunity identification and ambidextrous strategic combination, contributing to the theoretical gap in the systematic study of opportunity identification, ambidextrous strategic combination, and resource-focused actions. Moreover, based on the profound insights of extant research on cross-domain ambidextrous strategies, this study explores the choice of ambidextrous strategic combinations in the iterative innovation process of enterprises and further investigates the differentiated configuration of different attribute competitive advantage modules, making a beneficial contribution to the micro-level research on ambidextrous strategic research and the effective integration of enterprise competitive advantages. From a practical perspective, the iterative innovation of enterprises is driven by the synergistic matching of opportunity identification and ambidextrous strategic combination, which inspires enterprises to adopt differentiated strategies and asymmetric paths, focus on different resource contexts, achieve adaptability interaction between opportunities and resources, and emphasize the balanced and leveraged market-technology and exploration-exploitation dual-wheel driving and synergy, promoting the iterative innovation of development models.

This study only explores the process of resource-focused action evolution and iterative innovation under the synergy of opportunity identification and ambidextrous strategic combination from the perspective of technology-based SMEs. Due to the potential differences in resource contexts and organizational environments faced by different types of enterprises, future research can enrich the types of enterprises or consider the influence of other internal and external factors to validate the research conclusions. Additionally, further exploration can be conducted on other methods of competitive advantage building, beyond the four methods of resource heterogeneity, pre-competition constraints, incomplete factor-mobility, and post-competition constraints.

Acknowledgments This paper is a key project of National Social Science Foundation of China (No. 18AKS008), a major philosophy and social sciences research project of the Ministry of Education of China (No. 19JZD025), and a project funded by Guangdong Provincial Science and Technology Program (No. 2017A010106001).

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