

Chokepoint Technologies: Concepts, Characteristics, and Influencing Factors

Authors: Yan Dongao, Chen Fang, Chen Fang

Date: 2023-06-23T00:00:00+00:00

Abstract

Purpose/Significance Addressing the organizational requirements for research breakthroughs in chokepoint technologies, this study departs from the conceptual characteristics and influencing factors of chokepoint technologies, analyzing research papers and news interview materials to investigate the factors influencing the formation of chokepoint technologies, thereby supporting the planning of breakthrough pathways.

Method/Process Employing the “genus concept + specific difference” method to define chokepoint technology and summarize its characteristics, this research takes the influencing factors of chokepoint technology formation as its research question. By adopting the coding method from grounded theory, it analyzes relevant corpus texts on chokepoint technology to construct a model of influencing factors for chokepoint technology.

Results/Conclusions Chokepoint technology is defined as the current-stage, non-independently controllable industrial technology that innovation entities have strategically selected, characterized by originality, strategic significance, and high investment intensity. Grounded coding results reveal that factors influencing chokepoint technology formation primarily encompass five dimensions: industrial differentiation, competitive gaming, innovation systems, production factors, and production transformation. Industrial differentiation and competitive gaming constitute external influencing factors, wherein industrial differentiation serves as the prerequisite foundation for competitive gaming, while competitive gaming represents the developmental outcome of industrial differentiation. Innovation systems, production factors, and production transformation constitute internal influencing factors, forming pairwise interactive relationships among them. A comprehensive understanding of the concept, characteristics, and influencing factors of chokepoint technology facilitates more effective planning of breakthrough pathways in this domain.

Full Text

The Bottleneck Techniques: Concept, Features, and Influencing Factors

Yan Dongao¹², Chen Fang^{12*} ¹Department of Information Resources Management, School of Economics and Management, University of Chinese Academy of Sciences, Beijing 100190, China ²Chengdu Library and Information Center, Chinese Academy of Sciences, Chengdu 610299, China

Abstract

[Purpose] This study investigates the concept, features, and influencing factors of bottleneck techniques to support strategic planning for technological breakthroughs in response to the organizational demands of research and development efforts targeting these critical constraints. **[Methods]** We employ the “genus-differentia” method to define bottleneck techniques and summarize their distinctive characteristics. Using the formation of influencing factors as our research question, we apply grounded theory coding methods to analyze relevant textual corpora, constructing a comprehensive influencing factors model. **[Results]** Bottleneck techniques are defined as strategically selected, currently non-autonomous controllable industrial technologies pursued by innovative entities, characterized by originality, strategic importance, and substantial investment requirements. The influencing factors in their formation are categorized into five dimensions: industrial differentiation, competitive game, innovation system, production factors, and production transformation. **[Limitations]** The grounded coding materials are predominantly Chinese corpora, lacking analytical data from countries imposing technical sanctions. **[Conclusions]** Industrial differentiation and competitive game constitute external influencing factors, where industrial differentiation serves as the prerequisite foundation for competitive game, which in turn represents the developmental outcome of differentiation. The innovation system, production factors, and production transformation represent internal influencing factors that interact pairwise, where change in one dimension triggers corresponding changes in the others.

Keywords: bottleneck techniques; conceptual features; grounded theory; influencing factors

Addressing the challenge of bottleneck techniques is imperative for China to safeguard industrial and supply chain security, uphold independent scientific and technological development, ascend to the forefront of innovative nations, and build itself into a world-class science and technology powerhouse. From the perspective of national security and self-interest, the United States—since the Trump administration—has witnessed the rise of technological nationalism, transformed its national security concept to pursue “absolute security,” and insisted on maintaining comprehensive advantages over China in techno-

logical competition, positioning China as a comprehensive strategic competitor \cite{唐璐 _ 张志强 _{2022}}. This has further deteriorated China's external environment for scientific and technological development. The U.S. government has continuously expanded its scope of technology export controls domestically while attempting to contain China's technological advancement by constructing a "technology alliance" with allied nations internationally \cite{凌胜利 _ 雒景瑜 _{2021}}, creating risks of disruption in China's industrial technology chains and product supply chains \cite{ZAKLYAZ'MINSKAYA_{2022}}. From the perspective of achieving technological independence and building a science and technology powerhouse, China's bottleneck technique issues reflect systemic weaknesses in basic scientific research, technology talent cultivation, and innovation organizational models \cite{钟贞山 _ 王希金 _{2023}}, posing comprehensive challenges to China's goal of becoming a science and technology powerhouse.

Bottleneck techniques represent vulnerable areas in China's response to technological sanctions challenges and constitute a dynamically evolving problem list during the process of technological breakthroughs. While existing scholarship has examined the concept and characteristics of bottleneck techniques, consensus on their conceptual core remains elusive. This paper explores the conceptual features and influencing factors of bottleneck techniques to provide support for the organizational work of technological breakthroughs.

1 Conceptual Connotation of Bottleneck Techniques

The term "bottleneck" in Chinese dictionaries describes critical moments of fatal obstruction [?]. Bottleneck techniques gained prominence as a high-frequency term following the series of U.S. sanctions and blockades against China's high-tech sectors in 2018. Existing research approaches the concept from four main perspectives: technology gap, national strategy, critical technology clusters, and international competition. The technology gap perspective describes the prerequisite for bottleneck techniques' existence; international political games and technological competition depict their external environment; monopoly status and core positions in industrial chains emphasize their value foundation; and technology units and knowledge chains describe their organizational systems.

These analytical perspectives locate and describe bottleneck techniques from different dimensions, reflecting their fundamental characteristics. However, existing descriptions have yet to address discussions of core features, leaving ambiguous zones between bottleneck techniques and related concepts.

1.1 Definition Principles

In defining bottleneck techniques, this paper employs the "genus-differentia" method for logical reasoning. This common definitional approach places a concept within its genus and reveals its differences from other species concepts under the same genus \cite{丁海斌 _{2022}}. Following this logic, defining

bottleneck techniques requires: first, identifying the genus concept within the technology classification system to locate its immediate superordinate category; and second, based on specific contexts, clarifying its differences from concepts at the same level or similar categories.

1.2 Conceptual Definition

Bottleneck techniques belong to the technology category. Identifying their genus concept requires clarifying the technology classification system employed. Technologies can be classified by various criteria: by industrial sector (agriculture, forestry, manufacturing), by discipline (physics, chemistry, biology), or by application domain—G. Tessey’s technology development model categorizes technologies into basic, generic, and proprietary technologies \cite{熊焰 _ 刘一君 _ 方曦 _{2018}}. Existing classification systems prove incompatible with bottleneck techniques, primarily because they fail to achieve both clear boundaries between sub-concepts and logical completeness. In conceptualizing bottleneck techniques, establishing a complete, logical classification scheme is the first problem to solve.

Three main judgments guide the construction of a classification system that includes bottleneck techniques: (1) bottleneck techniques should be mature technologies that have entered market application; (2) bottleneck techniques belong to technologies for which China has not yet fully mastered independent intellectual property rights; and (3) bottleneck techniques typically occupy critical positions and play dominant roles in industrial technology systems.

First, technologies can be divided into four main stages by development process: research, development, testing, and application. At the first level of the technology classification system, we categorize technologies by lifecycle into industrial technologies, laboratory technologies, and technological concepts. Industrial technologies correspond to the mature stage of the technology lifecycle, enabling mature market application; laboratory technologies correspond to testing stages such as pilot trials; and technological concepts correspond to project initiation and R&D stages. A crucial feature of bottleneck techniques is that they have entered the mature stage of technological development—technologies in research, development, or testing stages should not be classified as bottleneck techniques.

Second, we divide industrial technologies into autonomous controllable and non-autonomous controllable technologies based on whether China masters independent intellectual property rights. A second prominent feature of bottleneck techniques is that China does not possess fully controllable intellectual property rights, placing them in the non-autonomous controllable category. Technologies already achieving autonomous control do not fall within the discussion scope.

Finally, not all technology sectors face bottleneck problems. Bottleneck techniques are context-dependent concepts meaningful only under specific conditions \cite{张玉臣 _ 谭礼 _{2023}}. The limited nature of national resources and

R&D investment means we cannot master or overcome all technology categories. Combining specific contexts such as “international competition,” “economic monopoly,” and “technology sanctions,” we further divide non-autonomous controllable technologies into general foundational technologies and bottleneck techniques. General foundational technologies represent supporting technologies widely used in certain industries or technical fields. Bottleneck techniques differ from general foundational technologies in two aspects: first, given limited social resources, bottleneck techniques possess higher R&D priority; and second, international political games and technological competition concern national interests, making bottleneck techniques unobtainable through normal market activities under specific conditions.

In summary, the genus concept (immediate superordinate category) of bottleneck techniques is “non-autonomous controllable industrial technology,” while the differentia—the distinction from general foundational technologies—is that bottleneck techniques possess R&D priority and technological scarcity. For both technology holders and those seeking breakthroughs, they represent products of strategic choice. This paper defines bottleneck techniques from the perspective of those seeking technological breakthroughs: bottleneck techniques are strategically selected, currently non-autonomous controllable industrial technologies that are crucial for national security and economic-social development but not yet independently mastered.

2 Main Features of Bottleneck Techniques

Existing research primarily describes bottleneck techniques from four aspects: criticality \cite{郑国雄_李伟_刘澔_等_{2021}}, strategic importance \cite{张治河_苗欣苑_{2020}}, uniqueness, and complexity \cite{江瑶_陈旭_胡斌_{2023}, 高旭_白如江_王效岳_{2023}}, emphasizing their key role in industrial development, strategic significance in national economic development and competitive security, monopoly status held by few technology actors, and technological gaps difficult to close in short timeframes. Building on the conceptual connotation, this paper proposes three key features.

2.1 Originality from the R&D Perspective

The technology system is a collection of diverse knowledge, with bottleneck techniques representing knowledge-intensive components and important constituents of scarce knowledge units. Technology integration and technological innovation are two modes for solving production problems. In knowledge-dense technology systems, practical problems often require original technological breakthroughs. Bottleneck techniques typically involve knowledge and methods from multiple disciplinary fields, demanding high levels of basic research and breakthroughs beyond existing technological boundaries, requiring innovative thinking and independent technological exploration to advance frontier knowledge creation.

2.2 Strategic Nature from the Technology Layout Perspective

The strategic feature of bottleneck techniques manifests in two aspects. First, for technology holders, bottleneck techniques are technologies actively planned and developed by industry-leading entities based on industrial competition strategies. They must be both irreplaceable and difficult to imitate, ensuring that technologically leading entities gain competitive discourse power through technological scarcity. Second, for technology-restricted parties, bottleneck techniques concern their industrial security and strategic layout, representing industrial technologies selectively developed for breakthroughs based on resource and strategic development needs. Bottleneck techniques wield significant strategic influence over the restricted country's industrial development, economic level, and even national security.

2.3 High Investment Requirement from the Breakthrough Perspective

Bottleneck techniques constitute high-density knowledge systems whose breakthrough demands substantial human, material, and financial investment, evident in both R&D and application stages. During R&D, bottleneck techniques require concentrating superior resources and organizing multidisciplinary, multi-domain, multi-level collaborative innovation to form effective breakthrough mechanisms. In the application stage, they require establishing complete industrial chains and market systems to promote technology transformation and dissemination, creating favorable environments for technological research and creation.

3 Influencing Factors in the Formation of Bottleneck Techniques

Existing research on the causes of bottleneck techniques can be summarized into three aspects: weak links in basic research and innovation coordination \cite{任文华_2021}; insufficient technology accumulation in latecomer countries determined by technological development patterns \cite{邢冬梅_2020}; and underdeveloped micro-level innovation ecosystems \cite{梁帅_高继平_2021}. Building on existing research, this study employs grounded theory coding methods to analyze textual corpora and explore influencing factors.

3.1 Research Methods and Data Sources

(1) **Research Methods.** Grounded theory is a qualitative research method commonly used in analyzing social phenomena. Through continuous conceptual coding and integration of similar concepts from corpus data, it abstracts the essence and patterns of problems to construct relevant theoretical models. Professor Jia Xudong of Lanzhou University \cite{贾旭东_衡量_2016}, 贾旭东_解志文_2023 integrated three major schools of grounded theory—classical, procedural, and constructivist—to propose a Chinese management grounded research paradigm, dividing the grounded analysis process into five

parts: problem emergence, data collection, data processing, preliminary theory construction, and theory testing. This paper borrows the coding methods from Professor Jia's Chinese management grounded research paradigm to process relevant data.

(2) Data Sources. In data collection, this paper adheres to grounded theory's principle that "everything is data," collecting bottleneck technique-related textual materials from search engines and literature databases. In the CNKI database, using "bottleneck technique" and "critical core technology" as search terms, we selected 83 texts from core journals, master's and doctoral dissertations, and news collections. Using search engines, we retrieved 19 additional news reports and interview corpora as supplementary texts.

3.2 Research Process

Drawing on the coding process of the Chinese management grounded research paradigm, this paper conducts open coding, selective coding, and theoretical coding on the textual corpora using Nvivo11 Plus software.

(1) Open Coding. In the open coding stage, we inductively abstracted key concepts from the collected corpora. The process involved: (a) extracting relevant expressions about bottleneck techniques' conceptual connotation, features, and formation causes; (b) conceptual coding by simplifying and preliminarily refining these expressions into corresponding concepts. This yielded 121 concepts with 715 marking points, using letter X plus numbers (e.g., X1) to display partial data, where X represents original text and Y represents conceptual categories after first coding. Ultimately, 42 initial categories were obtained, with open coding results partially shown in Table 2 .

(2) Selective Coding. In the selective coding stage, we further abstracted and condensed the concepts from open coding, organizing similar concepts into corresponding categories and determining relationships among concepts and categories. We generalized the 42 initial categories into 13 main categories, represented by lowercase letter z plus numbers (e.g., z1). The selective coding process extracting main and core categories is shown in Table 3 .

(3) Theoretical Coding. Based on selective coding, theoretical coding examines relationships among categories to construct theoretical models. The research theme is "influencing factors in the formation of bottleneck techniques." Centering on this theme, among the 13 main categories, technical patterns and global division of labor belong to the industrial differentiation level (Z1); economic monopoly and political game belong to the competitive game level (Z2); innovation actors, basic research, and industry-university-research collaboration belong to the innovation system level (Z3); material constraints, process constraints, and equipment constraints belong to the production factors level (Z4); and technology layout, application transformation, and user market belong to the production transformation level (Z5). The five core categories and their sub-category relationships are shown in Table 4 .

(4) Theoretical Saturation Test. Theoretical saturation occurs when no new categories or concepts emerge during coding of reserved texts. When testing coding on reserved samples, the extracted categories and concepts essentially reached saturation without generating new ones, prompting us to stop coding.

(5) Model Construction. Based on the above analysis and existing literature, we developed the influencing factors model for bottleneck technique formation shown in Figure 1 [Figure 1: see original paper].

3.3 Theoretical Explanation

In constructing the model, we categorize industrial differentiation and competitive game as external influencing factors, where industrial differentiation serves as the prerequisite foundation for competitive game, which in turn represents the developmental outcome of differentiation. The innovation system, production factors, and production transformation are categorized as internal influencing factors that interact pairwise, where change in one dimension triggers corresponding changes in the other two.

(1) Industrial Differentiation Level. Industrial differentiation is a product of economic and trade globalization, where countries or regions specialize in producing and trading certain products or services based on comparative advantages to improve efficiency and quality while reducing costs and risks, thereby promoting international trade and economic growth. However, industrial differentiation may also lead certain countries or regions to form monopolies in critical links, creating technological constraint advantages over others. Influencing factors at this level can be divided into technical patterns and global division of labor.

In the technical patterns dimension, factors include the accumulative nature of technology trajectory development, strategic deployment of upstream enterprises, and difficulty for downstream enterprises to master technologies. Technological development patterns represent general experiences in the research-testing-transformation-application process. As members of technology families, bottleneck techniques inevitably follow these general patterns from research to application. Technological innovation and evolution follow certain paths and logics, forming technology chains from low-end to high-end, basic to applied, and single to composite. When a technology approaches its limit within an existing paradigm, technological opportunities diminish sharply, causing innovation motivation shortages and narrow innovation paths that lead to bottleneck phenomena. In the global division of labor dimension, upstream enterprises in industrial chains, based on their grasp of overall industrial development and their own strategies, select high-value technologies for deployment. Such technologies, designed to ensure competitive discourse power for technology owners, are generally difficult for downstream enterprises to acquire in short timeframes.

(2) Competitive Game Level. International competition is an important driver of technological innovation and progress but may also lead to unequal

distribution and control of technology. Some countries or regions might employ unfair competition methods to obtain huge profits or achieve political goals due to their core patents. Influencing factors at this level can be divided into economic monopoly and political game.

In the economic monopoly dimension, factors include relatively concentrated supply channels, technology blockades initiated by competitors, supply disruptions triggering industrial chain ruptures, and overseas enterprises monopolizing domestic markets. Economic monopoly typically reduces technology accessibility and substitutability while increasing dependency and risk. For instance, Google, Apple, and Microsoft dominate search engines, operating systems, and office software, constraining innovation and choice spaces for other enterprises and users. Political game involves political intervention to alter market supply-demand relationships, artificially creating technological conflicts or sanctions. In the political game dimension, factors include technology sanctions under national security pretexts that disrupt normal trade order. As geopolitical competition intensifies, governments of countries monopolizing key technologies can use them to constrain industrial technology or enterprise development in other countries, representing an important external factor in bottleneck technique formation.

(3) Innovation System Level. The innovation system comprises a social network of government, enterprises, research institutions, and universities oriented toward innovation. As an important driver of R&D and innovation, various actors in the system conduct research and creation according to their own needs and goals. Influencing factors at this level include basic research, industry-university-research collaboration, and innovation actors.

In the basic research dimension, insufficient technology data accumulation, unclear research implementation, using technology integration to avoid fundamental R&D, and inadequate basic research support for technological development are internal factors behind existing bottleneck techniques. In the industry-university-research collaboration dimension, while China's collaboration has increased quantitatively, qualitative improvement is still needed. Currently, no effective coordination mechanism has formed, resulting in inconsistent interest appeals, goal orientations, and working methods that prevent synergy. On one hand, industry has low recognition of academic achievements, perceiving academic research as overly theoretical, detached from reality, and difficult to apply. On the other hand, academia pays insufficient attention to industry needs, viewing industrial problems as overly simple, lacking innovation, and uninteresting. These factors lead to poor collaboration effects that fail to provide effective support and guarantee for bottleneck techniques. In the innovation actors dimension, the main manifestations are insufficient leading talent and enterprises. Talent is the source of innovation, and enterprises are important innovation actors in China. Insufficient accumulation of key talent and leading enterprises in technology-restricted industrial fields results in inadequate innovation momentum and motivation. Professional talent reserves are crucial

factors supporting healthy industrial development and achieving technological breakthroughs and transformation.

(4) Production Factors Level. Production factors are the foundation of technology manufacturing. Any technology relies on three basic processes: raw materials, production equipment, and process control, corresponding to materials, equipment, and processes in the production factors domain. Therefore, influencing factors at this level mainly include material constraints, equipment constraints, and process constraints.

China's basic processes, core technologies, key materials, and important equipment in certain scientific fields primarily depend on technology introduction or equipment import, facing risks of external technology blockades. In the material constraints dimension, material performance, specifications, quality, quantity, and production-supply capacity are all important factors affecting technology implementation. In the equipment constraints dimension, core equipment is the foundation and carrier of technological innovation. Without independent R&D and manufacturing capabilities, it is impossible to master technology sources and cores or form independent intellectual property rights and brand advantages. For example, in chip manufacturing, advanced photolithography technology and market share are monopolized by a few foreign enterprises, creating enormous difficulties and dependencies for domestic chip manufacturers. In the process constraints dimension, insufficient manufacturing precision and unstable product yield rates make it difficult for certain critical links or components to meet expected standards, preventing products or systems from competing with rivals in quality, cost-effectiveness, and delivery time.

(5) Production Transformation Level. Production transformation refers to the process of converting scientific research results into actual products or services. Difficulties in breaking through certain key technologies or links may obstruct the entire transformation process. The bottleneck problem reflects not only the absence of single technologies but also the immaturity of technology systems. Influencing factors at this level mainly include technology layout, user market, and application transformation.

In the technology layout dimension, the main manifestations are narrow technology scope, inability of domestic manufacturers to produce products, and low patent integration. Scientific and rational technology layout can optimize technology structure and resource allocation, improve technology efficiency and benefits, and enhance comprehensive competitiveness and risk resistance. Some enterprises or competitive actors lack risk awareness, resulting in poor resistance capabilities when external forces intervene in normal market activities. In the user market dimension, the main manifestation is that self-developed products lack user ecosystems and, due to inferior performance compared to foreign flagship products, have low market share domestically and internationally. Transitioning from technology R&D to application is crucial in bottleneck technique breakthrough, and achieving scaled application requires favorable user ecosystems. In the application transformation dimension, some of China's industrial

technology systems are underdeveloped, lacking batch production lines and having small-scale practical engineering with insufficient industrial support. China's core technology transformation mechanisms need improvement, with many technologies still remaining at the laboratory research stage without achieving marketization. The driving effect of technology science on R&D creation is not obvious, and the "feedback" to basic science development is insufficient.

4 Discussion and Outlook

This paper first systematically analyzed the conceptual connotation of bottleneck techniques, defining them as strategically selected, currently non-autonomous controllable industrial technologies from three dimensions—technology lifecycle, degree of technological autonomy, and strategic choice context—and summarized their features of originality, strategic importance, and high investment requirements. Subsequently, using grounded theory coding methods, we analyzed textual corpora to examine influencing factors in bottleneck technique formation across five dimensions: industrial differentiation, competitive game, innovation system, production factors, and production transformation. However, this study has certain limitations. Future research can deepen understanding in several directions: (1) Expand corpus sources by incorporating export control texts such as the U.S. Commerce Control List and Entity List to test and refine the influencing factors model. (2) Design an identification indicator framework for bottleneck techniques based on the qualitatively constructed theoretical model, quantify the impact degree of various factors, and test the model's validity. (3) Explore breakthrough pathways for bottleneck techniques from the perspective of research and development organization to provide support and services for China's bottleneck technique breakthrough efforts.

References

- [1] Tang Lu, Zhang Zhiqiang. Analysis and Implications of the "U.S. National Technology Strategy" Report from the Center for a New American Security [J]. Library and Information Service, 2022, (01): 49-56.
- [2] Ling Shengli, Luo Jingyu. The Biden Administration's "Technology Alliance": Motivations, Content, and Challenges [J]. International Forum, 2021, 23(06): 3-25+155.
- [3] ZAKLYAZ'MINSKAYA E O. China's Scientific and Technological Potential under US Technological Sanctions [J]. HERALD OF THE RUSSIAN ACADEMY OF SCIENCES, 2022, 92(5): 643-9.
- [4] Zhong Zhenshan, Wang Xijin. Technological Self-Reliance and Strength in the New Era and Comprehensively Building a Modern Socialist Country: An Analysis of General Secretary Xi Jinping's Important Discourse on Achieving

Breakthroughs in Key Core Technologies [J]. Journal of Hubei University (Philosophy and Social Sciences Edition), 2023, 50(01): 10-9+174.

[5] CNKI. CNKI Dictionary - Bottleneck Technique [EB/OL]. [2023-05-10]. <https://cidian.cnki.net/result?sysid=112&s=vs1&f=vs1&v=%E5%8D%A1%E8%84%96%E5%AD%90>.

[6] Chen Guang. Key Factors for Major Innovation Breakthroughs in China from the Perspective of the P-TMO Model [J]. Governance, 2020, (45): 15-20.

[7] Dong Kun, Bai Rujiang, Xu Haiyun. Identification and Analysis of Potential Bottleneck Techniques in Industries from a Provincial Perspective: A Case Study of Shandong's Blockchain Industry [J]. Information Studies: Theory & Application, 2021, 44(11): 197-203.

[8] Xu Xia, Wu Fuxiang, Wang Bing. Research on Identification of Key Core Technologies Based on International Patent Classification [J]. Journal of Intelligence, 2022, 41(10): 74-81.

[9] Chen Jin, Yang Zhen, Zhu Ziqin. Breaking Through Bottleneck Techniques During the "14th Five-Year Plan" Period: Identification Framework, Strategic Shift, and Breakthrough Paths [J]. Reform, 2020, (12): 5-15.

[10] Jiang Yao, Chen Xu, Hu Bin. Research on Construction and Application of a Two-Stage Funnel Selection Model for Bottleneck Key Core Technologies [J]. Journal of Intelligence, 2023, 42(03): 94-101.

[11] Li Jing. Research on Causes, Breakthrough Capability System, and Paths of Bottleneck Techniques [J]. High-Technology & Industrialization, 2022, 28(08): 58-63.

[12] Li Yuxuan, Fang Weihua. Conceptual Analysis of Bottleneck Techniques: Co-construction of Endogenous Contradictions, National Subjects, and External Constraints [J]. Studies in Science of Science: 1-15.

[13] Wang Luyao, Qu Guannan, ROGERS J. Analysis of Knowledge Innovation Ecosystem for Bottleneck Problems: Core Challenges, Theoretical Construction, and Practical Paths [J]. Science Research Management, 2022, 43(04): 94-102.

[14] Ding Haibin. Revisiting the Definition and Understanding of Archives [J]. Archives Management, 2022, (02): 5-7+11.

[15] Xiong Yan, Liu Yijun, Fang Xi. Theory and Practice of Patent Technology Transfer [M]. Beijing: Intellectual Property Publishing House, 2018.

[16] Zhang Yuchen, Tan Li. Conceptual Definition, Characteristic Analysis, and Breakthrough Paths of Key Core Technologies [J]. China Science and Technology Forum, 2023, (02): 20-9.

[17] Zheng Guoxiong, Li Wei, Liu Gai, et al. Research on Selection of Bottleneck Key Technologies Based on Delphi Method and Analytic Hierarchy Process: A Case Study of Biomedicine [J]. World Science and Technology Research and Development, 2021, 43(03): 331-43.

- [18] Zhang Zhihe, Miao Xinyuan. Research on Selection Mechanism of Bottleneck Key Core Technologies [J]. Journal of Shaanxi Normal University (Philosophy and Social Sciences Edition), 2020, 49(06): 5-15.
- [19] Gao Xu, Bai Rujiang, Wang Xiaoyue. Research on Frontier Discovery and Evolution of Science and Technology for Bottleneck Technique Scenarios: A Case Study of Integrated Circuit Technology [J]. Library and Information Service: 1-15.
- [20] Ren Wenhua. Research on Bottleneck Problems of Key Core Technologies from the Perspective of Qian Xuesen's View of Technical Science [J]. Scientific Management Research, 2021, 39(03): 33-8.
- [21] Xing Dongmei. Causes and Avoidance of Bottleneck Technique Problems: An Analysis from the Perspective of Technology Trajectory [J]. Governance, 2020, (45): 21-5.
- [22] Liang Shuai, Gao Jiping. Industrial Technology Structure and Characteristics of Bottleneck Techniques: A Case Study of High-End CNC Machine Tools [J]. Science & Technology Review, 2021, 39(24): 75-83.
- [23] Jia Xudong, Heng Liang. Preliminary Exploration of the Paradigm for Constructing Chinese Indigenous Management Theory Based on "Grounded Spirit" [J]. Chinese Journal of Management, 2016, 13(03): 336-46.
- [24] Jia Xudong, Xie Zhiwen. Research on Entrepreneurs' Core Competencies Based on Grounded Paradigm [J]. Chinese Journal of Management, 2023, 20(01): 1-13.

Corresponding author: Chen Fang (chenf@clas.ac.cn)

Author Contributions Statement: Yan Dongao: Conceptualized the research, designed the study, wrote the initial draft; Chen Fang: Revised the final manuscript.

Note: Figure translations are in progress. See original paper for figures.

Source: ChinaXiv — Machine translation. Verify with original.