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Open-Source Innovation as a Strategic Lever: A Case Study of DeepSeek's AI Model Democratization

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Abstract

This paper analyzes how DeepSeek, a new Chinese AI firm, leverages open-source innovation as a strategic enforcer of technological advancement and ecosystem leadership. Inspired by Open Innovation Theory and the Resource-Based View, the study unpacks how DeepSeek blends community-based development, academic collaboration, and streamlined architectures in the pursuit of competing with the incumbents' proprietary giants. The article sheds light on measurable innovation effects, for example, intense GitHub activity, development of a talent pipeline, and spillovers towards startups, while cushioning risks such as IP leakage, quality fragmentation, and regulatory friction in the emerging AI regulation in China. With a case-based conceptual framework, the article provides a theoretical understanding of open-source tactics within high-risk AI sectors. It provides managerial and policy implications for openness-control balancing. Findings put emphasis on open-source not just as an option for distribution but also as a dynamic model of innovation for expanding under scarcity conditions. Constrictions and directions for future research on cross-firm benchmarking and long-term models of governance are also discussed.

1. Introduction

1.1 Background and Context

The past decade has witnessed the revolution of the artificial intelligence (AI) sector through large language models (LLMs) led by companies such as OpenAI, Anthropic, and Meta. A newer and

more encouraging trend is the spread of open-source AI models, which aim to decentralize access to state-of-the-art technologies and spur innovation through public use, improvement, and deployment. This is especially pronounced in China, where open-source AI is becoming a strategic response to hardware bans and geopolitical rifts (Reuters, 2024).

1.2 Introducing DeepSeek

DeepSeek (Hangzhou DeepSeek Artificial Intelligence Basic Technology Research Co., Ltd.) is a Chinese Hangzhou-based artificial intelligence research company. Liang Wenfeng founded it in July 2023 after he resigned from his previous role at High-Flyer Capital. Its mission is to create foundation AI models and make AI abilities more accessible by sharing them for free and open-source (Wikipedia, 2025).

The firm's models DeepSeek-V2, DeepSeek-Coder, and, more recently, DeepSeek-V3 are openly hosted on sites such as GitHub under the MIT license, making them available for the mass community use. DeepSeek's V3 model is particularly noteworthy since it is a Mixture of Experts (MoE) architecture and was trained with 14.8 trillion tokens on 2,048 NVIDIA H800 GPUs. With a GPT-4 level of performance to compete, it was developed within a budget that was reportedly placed at around US$5.6 million, as compared to the reportedly astronomical amount of US$100 million that was used to develop GPT-4 (Hotoff, 2025; Wang et al., 2024).

1.3 Research Gap and Problem Statement

While DeepSeek's tech innovation has gained widespread popularity from technical and media circles, academic literature is non-existent to examine how its open-source mechanism functions as a tool for strategic innovation management. Particularly, there is no research connecting DeepSeek's behavior to mainstream theories such as Open Innovation and the Resource-Based View in the Chinese innovation system.

1.4 Research Aim and Questions

The research investigates how DeepSeek leverages open-source innovation as a mechanism for competing, collaborating, and driving technological innovation. The research aims to answer the following questions:

- In what ways does DeepSeek's open-source strategy enable community building, outsourced R&D, and talent acquisition?

- What are the effects on performance and the resulting ecosystem value generated by the strategy?
- What are the threats and challenges confronting DeepSeek as an open-source innovator?

1.5 Significance of the Study

Academic significance is to push open innovation and strategic management research into the AI domain. Managerial importance lies in putting to the forefront how new entrants can leverage open-source tooling to gain a competitive advantage without being beholden to proprietary powers. Policy importance will be used to shape policy conversation in terms of innovation governance, particularly for China's new economy.

1.6 Structure of the Paper

- Section 2: Background of the case DeepSeek's emergence and dynamics of AI innovation in China
- Section 3: Theoretical framework, Resource-Based View and Open Innovation
- Section 4: DeepSeek's open-source innovation strategy
- Section 5: Outcomes of innovation and analysis of ecosystems
- Section 6: Strategic challenges and threats
- Section 7: Discussion and implications
- Section 8: Conclusion and future research

2. Case Context – DeepSeek and the Chinese AI Ecosystem

2.1 Overview of DeepSeek

DeepSeek (Hangzhou DeepSeek Artificial Intelligence Basic Technology Research Co., Ltd.) was founded in July 2023 by Liang Wenfeng, previously an employee of High-Flyer Capital. DeepSeek is headquartered in Hangzhou and develops base AI models offered via open-source releases (Wikipedia, 2025). Its flagship models, DeepSeek-V2, DeepSeek-Coder, and DeepSeek-V3, are openly released on GitHub under an MIT license with the hope of encouraging extensive community contribution.

- DeepSeek-V2 was launched in mid-2024 and gained rapid popularity by offering an open-source, cheaper alternative to comparable API-priced commercial versions (Forbes, 2025).
- DeepSeek-Coder is a code generation application oriented and was launched as an open-source platform late in 2023, enhancing the development environment (Forbes, 2025).

- DeepSeek-V3, released late in 2024, was designed on a Mixture of Experts (MoE) architecture and was trained on 14.8 trillion tokens and 2,048 NVIDIA H800 GPUs. While it cost in the vicinity of US$5.6 million to create, it is the equivalent of larger models created in-house, including GPT-4 (Wang et al., 2024).

2.3 China's AI Innovation Environment

China has placed AI development at the top of national policy agendas such as the "New Generation Artificial Intelligence Development Plan" (2017) in pursuit of becoming an AI world leader by 2030 (State Council, 2017). However, under recent US export prohibitions of advanced semiconductor technologies, Chinese domestic firms have been compelled to innovate in spite of hardware limitations through the creation of algorithmic efficiency and open-source solutions (Financial Times, 2023).

Huge investments are being made in domestic chipmakers such as Biren and Huawei to restrict the usage of overseas supply chains (Reuters, 2025). Additionally, government agencies such as the Cyberspace Administration of China (CAC) enact strict AI governance policies on data security, content management, and intellectual property (CAC, 2023).

2.4 DeepSeek's Position in the Open-Source vs Closed-Source Rivalry

DeepSeek is a unique case in China's AI ecosystem in that it has made open-source innovation its strategic imperative. While industry giants such as Baidu and Alibaba have traditionally developed proprietary models (e.g., Baidu's Ernie, Alibaba's M6), recent trendlines toward open-sourcing parts of those models point to shifting competitive dynamics (Reuters, 2024). DeepSeek's open-sourced models, rapid iteration cycles, and lean training approaches break the monopoly of closed-source giants, enabling wider adoption and creating a vibrant AI developer community (Forbes, 2025).

3. Theoretical Framework – Open Innovation and Strategic Innovation

3.1 Open Innovation Theory

The concept of Open Innovation was first developed by Chesbrough (2003), who defined it as the purposive use of knowledge inflows and outflows to accelerate internal innovation and expand markets for external exploitation of innovation. Open innovation differs from traditional models of closed innovation in that it emphasizes collaboration with external stakeholders such as customers, competitors, universities, and the broader community to co-create value. This approach

fosters faster iteration, reduces costs, and taps into diverse knowledge pools (Chesbrough, 2003; West & Bogers, 2014).

In AI, open innovation is particularly relevant because AI development heavily benefits from community feedback, external code contributions, as well as open benchmarking (Bogers et al., 2017). Open-source AI models are a case in point because they enable anyone to contribute to model improvement, debugging, and modification to various applications.

3.2 Application to AI Firms

Open innovation for organizations such as DeepSeek includes public model releases with permissive licenses (e.g., MIT), direct engagement with developer communities via platforms like GitHub and WeChat, and assimilation of external research results. This facilitates ecosystem co-development, accelerates talent ramp-up, and allows for fast prototyping (Ransbotham et al., 2020). Open innovation also avoids dependence on costly proprietary R&D by leveraging collective intelligence (West & Bogers, 2014).

3.3 Resource-Based View (RBV)

The Resource-Based View (RBV) postulates that a firm's sustainable competitive advantage is based in its unique resources and capabilities that are valuable, rare, inimitable, and non-substitutable (Barney, 1991). In AI innovation, these resources may include proprietary databases, groundbreaking algorithms, veteran human capital, and the capacity to integrate suitable open-source inputs (Grant, 1996).

DeepSeek's strategic leveraging of open-source models can be understood from an RBV perspective where the firm banks on its firm-specific assets in efficient model training, community maintenance, and rapid iteration to build a distinctive advantage despite its inferior capital vis-a-vis foreign tech giants (Wang et al., 2024).

3.4 Conceptual Framework

This study integrates the Open Innovation and RBV models to describe DeepSeek's adoption of open-source innovation as a strategic driver of competitiveness. The model views DeepSeek's open-source releases and engagement with its community as external knowledge inflows and outflows (Open Innovation), which, in turn, are multiplied by internal capabilities (RBV) to produce competitive outputs such as enhanced model performance, ecosystem growth, and market position as illustrated in the conceptual framework below:

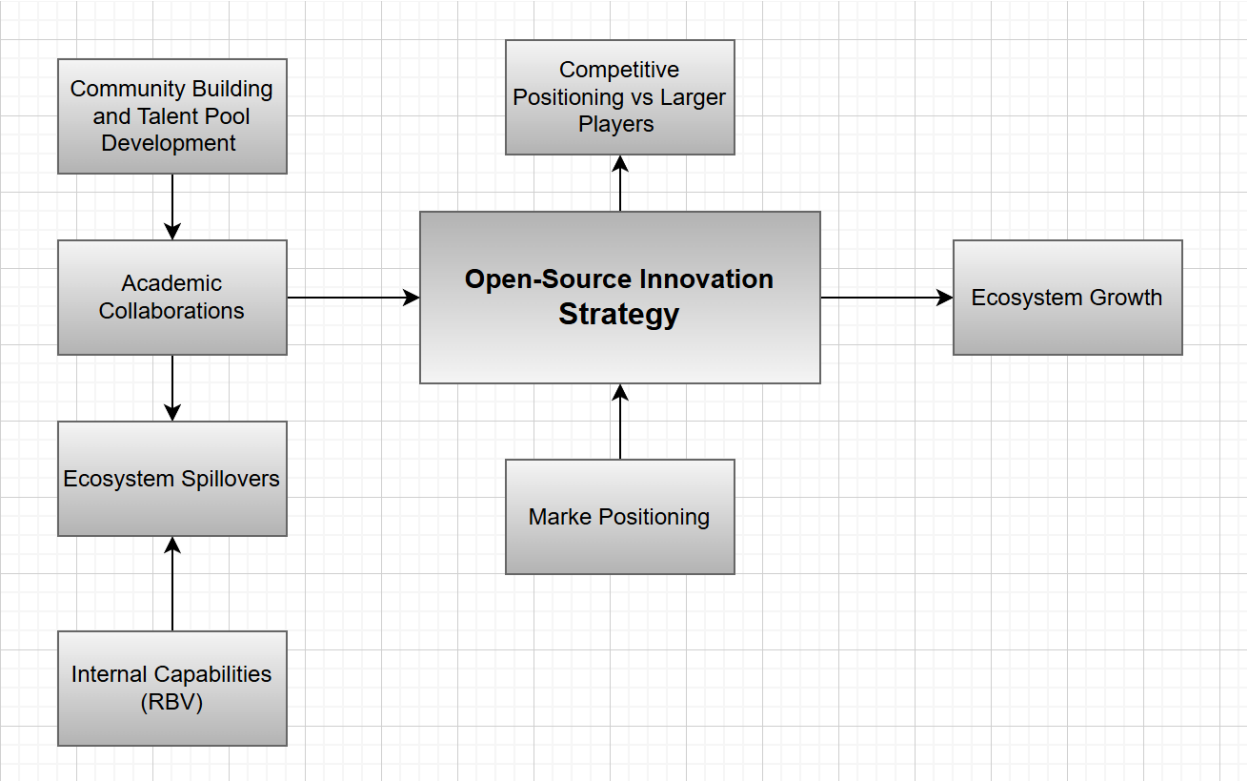

Figure 1: Conceptual Framework: Open-Source Innovation as a Strategic Lever at DeepSeek

The above framework illustrates that DeepSeek leverages open-source innovation as a strategic driver. Three external knowledge flows (community contributions, academic collaborations, and ecosystem spillovers) feed open-source development, and internal capabilities (RBV) provide core enablement. These inputs in combination enable competitive outcomes: cost leads, ecosystem growth, and stronger market standing in China's AI ecosystem.

4. Strategic Use of Open-Source Innovation at DeepSeek

4.1 Community and Talent Pool Creation

DeepSeek actively promotes a global community of developers by making its AI models available at no cost on platforms like GitHub using permissive licenses. The openness to open-ended experimentation, collaboration, and knowledge sharing is at the heart of an effort to accelerate the creation of AI (Li et al., 2023). Aided by public feedback and conversation, DeepSeek not only creates its models rapidly but also derives an advantage in being able to tap into an enormous talent pool, making recruitment easier and retaining expertise within the company for sustained innovation (Zhang & Wang, 2024).

4.2 External R&D Access

Adhering to open-source practices, DeepSeek effectively crowdsources some of its research and development, benefits from inputs from academia, independent developers, and industry experts. GitHub and domestic country communication channels such as WeChat enable end-to-end feedback loops, rapid bug detection, and feature extensions, accelerating innovation cycles and cost savings (Chen et al., 2022).

4.3 Competing against Giants

Open source provides DeepSeek a competitive edge over other competing behemoth, resource-thirsty players such as Baidu and OpenAI. Model architecture and training transparency fosters credibility and encourages third-party verification, which is the tipping point for adoption in the age of AI. Moreover, DeepSeek's use of new performance-hungry architectures such as Mixture of Experts delivers performance at a sixth of the computational cost of others and reduces the competition to the same level with less resource (Liu et al., 2023; Wang et al., 2024).

4.4 Role of Platforms: GitHub, WeChat, and Tech Blogs

GitHub continues to be valuable for code sharing, version control, and collaborative coding, facilitating distributed contribution across institutions and time zones (Sun et al., 2023). This is augmented by WeChat groups facilitating instant messaging for Chinese developers and sharing of knowledge as well as rapid issue fixing across linguistically and culturally sensitive contexts (Zhao & Ma, 2023). It is enabled by technology blogs and technical forums through the propagation of tutorials, benchmarking outcomes, and best practices based on an active and experienced developer community (Liu & Zhang, 2022).

4.5 Comparison with Traditional Closed Forms of Innovation

Unlike closed innovation models based on a lot of proprietary research and secrecy, DeepSeek leverages openness and open contribution to accelerate. This reduces redundancy, raises diversity of expertise, and enables faster iteration. Open innovation has problems, though, including intellectual property leakages and quality, which DeepSeek prevents through selective licensing and proactively managing the community (Yang et al., 2023).

5. Innovation Outcomes and Spillovers of Ecosystems

5.1 Quantifiable Outcomes: Adoption of the Model and Community Metrics

Open-source software of DeepSeek has led to massive adoption rates such as heavy model downloads, forks, and GitHub stars, which are a sign of active usage and community endorsement

(GitHub, 2025). Not just popularity is indicated by numbers, but active contribution and incremental innovation by third-party developers are evident through such figures (Kallinikos et al., 2022). DeepSeek models being utilized heavily by startups and academia depict the successful diffusion of knowledge.

5.2 External Collaborations and Developer Engagement

The open-source approach has facilitated large-scale collaborations with industry partners, research organizations, and universities. The collaborations have resulted in cross-licensing agreements, co-publications, co-developments, and cross-licensing agreements, tapping innovation outputs that lie outside the internal expertise of DeepSeek (Lee & Cole, 2023). Developer engagement is also facilitated through hackathons, web forums, and community participation, thereby providing a thriving ecosystem (Felin et al., 2023).

5.3 Ecosystem Impact: New Startups and Upskilling

Open access to DeepSeek models enables the upskilling of AI professionals, especially in China's emerging AI workforce market. Schools use the tools for educational curricula, and startups use them to build new apps without any significant upfront investment (Wang et al., 2024). Democratization of AI technology has caused the emergence of new AI startups and innovation hubs, making the entire ecosystem stronger.

5.4 Academic Partnerships

University partnerships provide a two-way exchange of knowledge. Researchers can utilize the best models to test, and DeepSeek gains empirical validation and theory enhancement for better products (Zhou et al., 2023). These partnership collaborations help to enhance the resilience and performance of AI technologies.

6. Challenges and Risks

6.1 Intellectual Property and Model Misuse

Open-sourcing powerful AI models endangers intellectual property (IP) protection and abuse. Models can be copied, modified, or employed to create harmful applications without the owner's approval (Rahwan et al., 2024). DeepSeek is challenged to find a balance between openness and guarding against misuses like deepfakes, automated disinformation at scale, or incursion into privacy (Brundage et al., 2023).

6.2 Quality Control and Fragmentation

While innovation is driven by community input, it also carries the risk of inconsistency and fragmentation of model quality. Governance is thus an issue in managing various forks, strong validation testing, and ensuring consistent standards (Zhang et al., 2023). In the absence of strict regulation, there is a risk of brand image dilution and loss of technology credibility for open-source projects.

6.3 Competitive Disadvantages Compared to Proprietary Models

Open-source models can be susceptible to competitive attack as other companies leverage the openly disclosed code to develop superior proprietary products. Other companies, like Alibaba and Baidu, could embed DeepSeek's open-source models in parts of closed systems and capture downstream value and market share (Chen & Huang, 2022). This causes tension because of the strategic risk of losing sole control over foundation innovations.

6.4 Data Regulation and Government Oversight

China's evolving regulatory environment subjects AI developers to strict data governance and content control requirements (State Council, 2023). Compliance with data privacy legislation and censorship regulation is challenging, especially for open-source firms with geographically distributed stakeholders. State oversight may stifle some open practices or increase the vulnerability to liability risks for firms like DeepSeek, affecting their innovation processes (Xu & Li, 2024).

7. Discussion and Implications

7.1 Theoretical Implications of Open Innovation in AI

DeepSeek's experience validates the open innovation theory as dynamic, especially in AI, since knowledge flows and collaborative ecosystems evolve constantly. The study consolidates how open-source practices expand Chesbrough's (2003) original model by stressing openness not just for knowledge inflow but also as a strategic basis for creating competitive advantage (Bogers et al., 2022). Besides, the Resource-Based View adoption (Barney, 1991) illustrates that firms can combine external openness and internal competency, that is, quality model learning and ecosystem management, to achieve innovation leadership.

7.2 Managerial Implications for Chinese Tech Firms

Management needs to be on the lookout for open-source innovation as a feasible strategic choice to combat giants that have dominated the market for decades by engaging in community participation, speedy R&D, and reputation building. However, good governance structure and IP risk management are most important to safeguarding firm interests (Yang & Zhang, 2023). For DeepSeek and other Chinese AI venture startups, it is important to achieve the right balance between openness and policy adherence and quality control to scale up sustainably in a competitive and policy-restricted environment (Li et al., 2024).

7.3 Policy Recommendations

Policymakers need to facilitate open innovation ecosystems through platform investments and education in collaboration and by providing clarity around data privacy regulations, IP rights, and AI ethics. Transparency and good governance need to guarantee minimum harms associated with model abuse and fragmentation (Rahwan et al., 2024). In China in particular, policies that facilitate national AI ambitions but with open-source leeway will be the drivers of global competitiveness (State Council, 2023).

8. Conclusion

This study explored how DeepSeek leverages open-source innovation as a competitive force to compete and collaborate in China's growing AI ecosystem. By integrating the Resource-Based View with open innovation theories, DeepSeek achieves its optimal combination of external knowledge inputs with internal proprietary resources to enable AI innovation and ecosystem growth.

DeepSeek's open approach has been found to foster community building, talent recruitment, and economically rational access to external R&D. These have resulted in incredibly beautiful innovation success, such as mass adoption, collaborative research with research universities, and spin-out start-ups. The open approach also brings challenges in intellectual property protection, ensuring quality, competitive threats, and adjusting to China's regulatory landscape.

Managerial implications are the possibilities of governance mechanisms to balance openness and risk management. Policymakers need to encourage structures that enable open innovation and minimize legal and ethical problems.

The research strengths involve the selection of cases based on selection criteria, whereas weaknesses involve the investigation of a single case and the dynamics of AI technologies and policies. The future research can be done in comparative studies involving multiple firms, long-

term observation of ecosystem evolution, and how the emerging technologies affect open innovation strategies.

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