Knowledge Intermediary Service Model Construction: A Case Study of Knowledge Intermediary Services for Enterprise New Product Development (Postprint)

Authors: Jiaming Cai, Zhao Shukuan, Bochen Zhang

Date: 2023-04-01T00:00:00+00:00

Abstract

[Objective/Significance] In the process of enterprise new product development, knowledge intermediaries connect core enterprises with various knowledge collaborators, facilitating the smooth progress of knowledge collaboration in each stage of new product development. This study matches appropriate knowledge intermediaries for knowledge collaboration in each stage of new product development, and subsequently constructs a knowledge intermediary service model, which is of significant importance for improving knowledge intermediary services and enhancing the innovation efficiency of core enterprises. [Method/Process] Knowledge intermediaries are divided into four categories. Based on the characteristics of knowledge collaborators and collaboration processes in each stage of new product development, appropriate types of knowledge intermediaries are matched, and subsequently, a knowledge intermediary service model for enterprise new product development is constructed. [Results/Conclusions] Agent-type intermediaries, partnership-type intermediaries, liaison-type intermediaries, and positioning-type intermediaries are respectively suitable for serving the knowledge collaboration between core enterprises and lead users, universities and research institutions, competitors, and suppliers. Various types of knowledge intermediaries provide services for different kinds of knowledge collaboration in new product development based on their own advantages.

Full Text

Knowledge Intermediary Service Model Construction: A Case Study of Knowledge Intermediary Services for Enterprise New Product Development

Cai Jiaming, Zhao Shukuan, Zhang Bochen
School of Management, Jilin University, Changchun 130022

Abstract:
[**Purpose/Significance**] In the new product development process, knowledge intermediaries connect core enterprises with various knowledge collaborators, facilitating knowledge collaboration across all stages. This study matches appropriate knowledge intermediaries to each stage of knowledge collaboration in new product development and constructs a knowledge intermediary service model, which is significant for improving intermediary services and enhancing core enterprise innovation efficiency.
[**Method/Process**] Knowledge intermediaries are classified into four categories. Based on the characteristics of knowledge collaborators and collaboration processes at each new product development stage, appropriate types of knowledge intermediaries are matched, and an enterprise new product development knowledge intermediary service model is constructed.
[**Result/Conclusion**] Agent intermediaries, partner intermediaries, connector intermediaries, and locator intermediaries are respectively suitable for serving knowledge collaboration between core enterprises and lead users, universities/research institutions, competitors, and suppliers. Each type of knowledge intermediary provides services for various knowledge collaborations based on its own strengths.

Keywords: new product development; knowledge intermediary; knowledge collaboration; matching study

---

As market competition intensifies, enterprises can no longer achieve high-level innovation relying solely on internal knowledge resources. More companies are gaining competitive advantages through open innovation [1]. In an open innovation environment, enterprises open their boundaries to collaborate with external organizations or individuals, achieving value co-creation. However, due to resource constraints, capability limitations, and knowledge differences between collaborating parties, open innovation between enterprises and external knowledge collaborators faces numerous obstacles. Knowledge intermediaries have emerged to help enterprises overcome these barriers by identifying collaborators and acquiring and utilizing external knowledge [2].

Over the past decade, knowledge intermediaries have matured significantly, with increasingly close relationships between enterprise R&D activities and these intermediaries. Knowledge intermediaries may be enterprise-built platforms such

as Haier' s HOPE platform [3] and Xiaomi' s MIUI community [4], or independent third-party platforms like InnoCentive [5] and NineSigma [6]; they may be government-funded non-profit organizations such as the UK' s AIRTO and EU' s RTO [2], or for-profit entities like TakeACoder and UpWork [6]. Open innovation environment knowledge intermediaries possess strong network-building, relationship-linking, and professional insight capabilities, enabling them to collect, transfer, and integrate knowledge across different domains, coordinate knowledge supply and demand, and effectively reduce transaction costs while improving innovation efficiency [7].

Existing research has explored the definition, functions, roles, and classification of knowledge intermediaries. J. Howells defined knowledge intermediaries as entities acting as brokers or agents in open innovation between two or more parties, surveyed 22 UK government-established knowledge intermediaries, and identified ten functions including technology forecasting, technology trading, outcome evaluation, and patent protection [2]. Li Wenyuan et al. categorized intermediary functions into three types: establishing connections, providing alliance and support services, and offering technical support services, using open innovation pioneer InnoCentive as a case study to examine how intermediaries help enterprises address open innovation challenges [5]. Other studies have classified knowledge intermediaries based on their functions: G. Colombo et al. distinguished four types based on differences in knowledge acquisition and transfer, using case studies to explore problems each type excels at solving [6]; Li Wenjian et al. revealed the role of knowledge intermediaries across startup life cycle stages, classifying them into four types and introducing service models for each [8].

Some studies have examined capability building and evolution: Chen Jiali et al., using a single-case longitudinal study of the rubber industry knowledge intermediary "Zhongyanwang" from a resource orchestration perspective, investigated resource building, integration, capability development, and evolution processes [9]; S. Sutthijakra et al.' s case study of Thailand' s hard disk industry intermediaries identified core capabilities including network linking, coordination, knowledge creation, and management [10]. Other research has explored impact mechanisms at macro, meso, and micro levels: S. Strambach et al. used case studies to reveal how intermediaries drive industry standard-setting [11]; O. Kokshagina et al. used exploratory case studies to show how intermediaries help core enterprises acquire and utilize distant knowledge when absorptive capacity is lacking [12]; K. Randhawa et al. conducted exploratory case studies across 18 organizations, identifying three mechanisms and practices through which intermediaries help online communities achieve open innovation [13].

Despite these contributions, gaps remain: (1) As knowledge intermediary services have matured, intermediaries have differentiated into types with different service foci, yet existing research has not adequately explored these classifications and characteristics; (2) Core enterprises collaborate with different external participants with varying collaboration characteristics, which existing research

has not sufficiently examined; (3) Knowledge intermediaries should be selected based on collaboration characteristics [14], but matching research is lacking. To address these gaps, this study first classifies knowledge intermediaries, then constructs a knowledge collaboration model between core enterprises and external participants based on the new product development process, analyzes collaboration characteristics at each stage, matches appropriate intermediaries, and finally constructs a knowledge intermediary service model for new product development.

2. Knowledge Intermediary Functions and Classification

Knowledge collaboration broadly refers to knowledge sharing, transfer, transformation, and co-creation [15]. From the core enterprise perspective, knowledge collaboration involves searching for external knowledge resources based on internal needs, reaching cooperation with resource owners, and generating new knowledge through acquisition, transfer, transformation, and integration. Enterprise new product development includes five stages: idea generation, research, development, prototype testing, and pre-production. Different external collaborators participate in open innovation at different stages, including customers, universities/research institutions, competitors, and suppliers. The knowledge distance between core enterprises and collaborators may be substantial, and core enterprises may not understand collaborators' knowledge bases, making it difficult to match appropriate partners. Even when matched, knowledge differences create barriers to understanding, hindering effective knowledge provision. This necessitates a third party for knowledge matching and transformation, highlighting the importance of knowledge intermediaries. With interdisciplinary backgrounds, intermediaries can analyze core enterprise needs, connect collaborators, and facilitate cooperation. During collaboration, they act as "translators," helping both parties understand, absorb, and utilize each other' s knowledge to generate new knowledge. Their primary role is coordinating knowledge collaboration between core enterprises and external resource owners to achieve cooperative innovation [16]. As open innovation deepens, intermediary functions have diversified to include market forecasting, demand diagnosis, technical consulting, collaborator scanning and positioning, intellectual property delegation, outcome trading, knowledge transformation, financing services, and knowledge management consulting, providing end-to-end support from product concept to market launch.

Existing research has classified knowledge intermediaries based on their services. G. Colombo et al. divided services into two phases: first, convening collaborators to provide knowledge; second, transferring collaborator knowledge to the core enterprise. Based on whether intermediaries can accurately locate collaborators according to needs in phase one and provide directly usable knowledge solutions in phase two, they identified four types: knowledge solution collectors, knowledge supply-demand connectors, knowledge transaction brokers, and knowledge dissemination intermediaries [6]. Li Wenjian et al. proposed four types: "gate-

keepers" bridging suppliers and receivers; "knowledge brokers" searching and integrating knowledge to provide direct solutions; "matchmakers" identifying providers and coordinating cooperation; and "knowledge consultants" offering consulting in technology development, market entry, and knowledge management [8].

Based on existing research, this study identifies two core functions: locating collaborators according to core enterprise needs and facilitating smooth collaboration [2]. All intermediary services derive from these functions. Accordingly, we divide services into two stages: (1) **Knowledge Matching Stage**—helping core enterprises find collaborators, either by precisely locating them or by publishing needs in a resource network for self-selection; and (2) **Knowledge Collaboration Stage**—promoting smooth collaboration, either by using domain expertise to translate knowledge into understandable forms or without providing translation services.

Based on these service patterns, we classify knowledge intermediaries into four types: **Agent Intermediary, Partner Intermediary, Locator Intermediary, and Connector Intermediary**, as shown in [Figure 1: see original paper].

Agent Intermediary: In the matching stage, encourages resource network participants to join open innovation without precise targeting. In the collaboration stage, provides knowledge transformation, integrating and converting collaborator knowledge for the core enterprise. Suitable when core enterprises need broad participation, require no precise targeting, and face large knowledge distances.

Partner Intermediary: In the matching stage, accurately locates collaborators based on needs. In the collaboration stage, uses professional knowledge to translate both parties' knowledge into mutually understandable forms, overcoming communication barriers. Suitable when core enterprises have limited understanding of potential partners and large knowledge distances.

Locator Intermediary: In the matching stage, precisely locates collaborators in the innovation resource network based on needs. Does not provide knowledge transformation in the collaboration stage. Suitable when core enterprises lack screening capabilities but knowledge distance is small and collaboration proceeds smoothly.

Connector Intermediary: In the matching stage, publishes needs in the innovation network, collects potential partner information, and allows core enterprises to evaluate and select partners. Does not provide knowledge transformation. Suitable when potential collaborators are limited, core enterprises have screening capabilities, and knowledge distance is small.

3. Knowledge Collaboration Analysis in Enterprise New Product Development

3.1 Types and Characteristics of Knowledge Collaborators

In an open innovation environment, external organizations and individuals collaborate with core enterprises throughout new product development, continuously providing new knowledge and technology. External collaborators mainly include lead users, universities/research institutions, competitors, and suppliers [17-18].

Under service-dominant logic (SDL), innovation shifts from technology-push to user-demand-pull. **Lead users** are those whose needs and preferences lead the market—they are more enthusiastic than average users about contributing to product innovation [19]. Lead users provide need knowledge and experience knowledge [20], helping generate product concepts and refine prototype designs. Their knowledge is voluminous and diverse, requiring systematic processing. Moreover, their input comes from an end-user perspective and must be translated into product design knowledge to guide R&D.

New product development often encounters technological bottlenecks that existing industry technologies cannot overcome, requiring collaboration with **universities and research institutions**. Their knowledge is forward-looking and more likely to achieve breakthroughs [21], but it is academically rather than application-oriented, making it difficult for enterprises to identify applicable technologies. Additionally, large knowledge and contextual differences require transformation before the knowledge can be utilized.

During R&D, high investment and risks make competitor-provided funding and knowledge resources valuable for reducing failure likelihood, leading core enterprises to form R&D alliances with competitors [22]. In fields like new energy and pharmaceuticals, competitor alliances have become common [23]. Collaboration with competitors can occur throughout development but mainly happens during the product development stage when core enterprises need complementary and auxiliary knowledge from the same industry. Both parties operate in similar technical standards and market environments with small knowledge distances, enabling efficient collaboration.

As product complexity increases and consumer demands rapidly change, integrating external suppliers into product design and production process improvement has become standard practice. **Supplier** collaboration mainly occurs in the pre-production stage, where suppliers improve production processes and design workflows based on core enterprise needs [24]. Core enterprises must identify suppliers with appropriate innovation and production capabilities. Suppliers share similar industrial environments with core enterprises, resulting in small knowledge distances and no significant knowledge gaps.

3.2 Knowledge Collaboration Process

Core enterprises collaborate with different external participants during new product development. Based on existing research, this study divides the process into five stages: idea generation, research, development, prototype testing, and pre-production [25-26]. Each stage includes knowledge matching and collaboration phases: (1) **Knowledge Matching**—outputting knowledge needs, matching collaborators, and reaching cooperation; (2) **Knowledge Collaboration**—external collaborators input knowledge, which core enterprises acquire, filter, absorb, transform, integrate, and innovate to generate new knowledge. This study constructs a knowledge collaboration model for new product development, shown in [Figure 2: see original paper].

Idea Stage: The initial fuzzy front-end before formal R&D, where the primary goal is preliminary product function design. Lead users are the main collaborators. In matching, core enterprises convene lead users with relevant product experience. In collaboration, lead users transfer need knowledge. Core enterprises filter and pre-process large volumes of need knowledge to improve usefulness and reduce absorption costs. The R&D team transforms filtered need knowledge into product design language, generating product concept knowledge, then screens for marketable and feasible concepts. After integrating internal knowledge and deconstructing concepts by functional modules for preliminary design, core enterprises translate these into innovation ideas understandable to lead users for further feedback. Through iterative cycles, final product designs emerge for the research stage.

Research Stage: An exploratory and experimental phase focused on breaking technical bottlenecks. When market technologies cannot overcome bottlenecks, universities and research institutions become crucial sources. In matching, core enterprises clarify needs, scan institutions, and locate collaborators based on knowledge resources. After negotiation, both parties clarify needs and resources to reach cooperation. In collaboration, institutions transfer knowledge resources that diffuse within the core enterprise R&D team. Through organizational learning, team members acquire external knowledge and activate internal knowledge, decomposing external knowledge into multi-granular, easily understandable forms [27]. Through deepening understanding and absorption, the team internalizes academic knowledge as applied knowledge, integrates it with internal knowledge, and generates breakthrough innovations through further knowledge creation.

Development Stage: After bottleneck breakthroughs, the product enters formal development, requiring complementary and auxiliary knowledge from industry peers. **Competitors** are the main collaborators. In matching, core enterprises collect competitive intelligence to understand potential partners' knowledge reserves, identify candidates, and reach cooperation through multi-round negotiations. In collaboration, both parties mobilize internal experts, activate internal knowledge for cross-boundary transfer, and absorb each other' s knowl-

edge. They integrate existing knowledge through linear (similar knowledge) and non-linear (different knowledge) integration [28], optimize knowledge, and generate new knowledge. Through cyclical transfer, fusion, and creation, product development completes.

Prototype Testing Stage: Lead users remain the primary collaborators. In matching, core enterprises convene capable lead users for prototype testing. In collaboration, lead users provide experience knowledge, with some offering improvement proposals based on their expertise [29]. Core enterprises first filter experience knowledge, remove duplicates and invalid information, and translate it into product design language to identify design issues and lock problem sources. For user proposals, R&D teams discuss them through brainstorming to generate better solutions. After defect correction and stability improvement, prototypes enter another testing round. Through multiple cycles, final product prototypes emerge.

Pre-production Stage: After stable prototype testing, **suppliers** become the main collaborators. In matching, core enterprises select suppliers based on technical needs. In collaboration, core enterprises provide product design, parameters, and technical standards, enabling suppliers to design production processes and improve manufacturing techniques, generating new knowledge and experience. Suppliers feedback production capabilities and new knowledge to core enterprises, who then refine product designs. Through multiple communication and improvement cycles, standardized production processes are finally established.

4. Analysis of Knowledge Collaboration and Intermediary Matching in New Product Development

Based on the four intermediary types' service foci and collaboration characteristics at each development stage, this study matches intermediaries to specific collaborations.

Lead Users collaborate with core enterprises during idea generation and prototype testing, providing creative and experiential knowledge. Since both stages involve similar collaboration processes, the same intermediary type can serve both. In matching, the goal is attracting broad participation from diverse user groups, so precise targeting is unnecessary. In collaboration, lead user knowledge is voluminous, dispersed, and redundant, requiring screening and transformation from user perspective to design language. **Agent Intermediaries** are suitable for this collaboration. Xiaomi' s MIUI fan community exemplifies this model, awarding medals to contributors to satisfy intrinsic motivation, encourage participation, and enable rapid identification and mobilization of lead users when needed [31]. The platform also aggregates, screens, and integrates user issues, categorizing them into hardware/software problems and subcategories for transformation and use by R&D departments.

Universities and Research Institutions collaborate during the research

stage. Their academically-oriented knowledge differs significantly from enterprises' application-oriented knowledge. In matching, core enterprises cannot accurately assess lab technology feasibility, requiring intermediaries with deep understanding of technology application prospects to precisely locate collaborators. In collaboration, large knowledge distances require intermediaries to translate academic knowledge into forms core enterprises can understand and apply. **Partner Intermediaries** are suitable. The rubber industry intermediary "Zhongyanwang" exemplifies this model, providing technology forecasting and diagnosis, scanning innovation resources to match collaborators, and assembling expert teams to help core enterprises absorb and integrate external knowledge for product development [11].

Competitors collaborate during the development stage. Both parties operate in the same market, enabling core enterprises to identify collaborators independently. In matching, intermediaries only need to issue invitations and collect cooperation intentions. With small knowledge distances, no translation is needed. Intermediaries function as independent third parties establishing cooperation mechanisms and benefit distribution, mediating disputes. **Connector Intermediaries** meet these needs, typically government-established industry associations like the UK' s AIRTO and its 56 member organizations, which encourage collaboration and provide IP consulting, legal advice, and arbitration [2].

Suppliers collaborate during pre-production. Although knowledge distance is small, numerous suppliers of varying quality make selection difficult. In matching, intermediaries must precisely locate qualified suppliers based on technical needs. In collaboration, direct knowledge exchange is possible without translation. **Locator Intermediaries** are suitable. Material ConneXion exemplifies this model: when BMW' s R&D team needed a fabric material for car surfaces (never previously applied in automotive contexts), Material ConneXion located suppliers capable of producing and improving the material, enabling successful collaboration and production of a fabric car cover for BMW' s concept car [6].

5. Knowledge Intermediary Service Model in New Product Development

Based on knowledge collaboration and matching results, this study constructs an enterprise new product development knowledge intermediary service model, shown in [Figure 3: see original paper].

(1) Agent Intermediary serves lead user collaboration. In matching, it publishes core enterprise needs in the innovation network, encouraging and mobilizing lead user participation, collecting basic information for orderly processing. In collaboration, it collects, screens, and processes creative and experiential knowledge. For user-proposed solutions, it conducts feasibility analysis, screening, integration, and ranking, transferring processed knowledge to core enterprises for design or prototype improvement.

(2) Partner Intermediary serves university/research institution collaboration. In matching, it diagnoses core enterprise technology, identifies bottlenecks and needs, locates potential collaborators, and facilitates cooperation, assisting with IP transfer procedures. In collaboration, it acts as a translator, helping institutions understand core enterprise needs while using professional knowledge and rich industry-academia experience to help core enterprises transfer, absorb, and understand academic knowledge, bridge knowledge gaps, and transform academic knowledge into applied knowledge to break technical bottlenecks. It also provides technical outcome testing and certification services.

(3) Connector Intermediary serves competitor collaboration. In matching, it issues invitations to competitors, collects potential partner intelligence, and provides market monitoring to aid evaluation and selection. After partner selection, it facilitates business negotiations, assists in developing cooperation and outcome distribution plans, and continuously provides consulting on technical standards and IP throughout collaboration, mediating disputes and actively applying for IP protection. For industry-leading results, it promotes participation in industry standard-setting [15] and provides financing for cash-strapped projects and policy support applications.

(4) Locator Intermediary serves supplier collaboration. In matching, it analyzes technical needs, establishes supplier screening criteria, invites qualified suppliers from the innovation network, and comprehensively evaluates production and innovation capabilities to select collaborators. In collaboration, it does not directly participate but provides consulting on technical standards and knowledge management.

6. Service Guarantee Measures for Knowledge Intermediaries

Knowledge intermediaries help match collaborators and facilitate collaboration, providing numerous derivative services based on these core functions. This study proposes the following guarantee measures.

6.1 Deeply Mining Core Enterprise Knowledge Needs

Intermediaries should thoroughly explore core enterprise knowledge needs through comprehensive review and discussion of details. For example, the intermediary Continuum holds "alignment and learning" meetings with core enterprise project management teams to fully discuss needs, help refine them, and demonstrate available resources [6]. This exchange stimulates new innovation ideas, uncovers potential needs, and continuously improves requirement lists while clarifying resource retrieval scope. It also builds trust, which is fundamental to successful cooperation.

6.2 Horizontally Expanding Service Boundaries

Intermediaries should expand service boundaries to provide comprehensive support: (1) In early development, offer technology forecasting and competitive

intelligence analysis for product innovation direction; (2) When matching collaborators, participate in negotiations from project management and legal perspectives to establish cooperation foundations; (3) In early collaboration, help develop cooperation plans, allocate tasks and schedules, and clarify IP ownership and outcome distribution; (4) During collaboration, use professional knowledge to resolve communication barriers and provide continuous consulting on technical standards and IP management. For cash-strapped projects, provide financing services. Intermediaries should offer full-process services from initial concept to final product.

6.3 Building Knowledge Resource Sharing Platforms

Core enterprises, intermediaries, and external participants generate rich knowledge resources through open innovation collaboration. A comprehensive, detailed, high-quality knowledge resource sharing platform should be established to better 挖掘 and utilize these resources. Intermediaries, occupying key positions in innovation networks, should lead platform establishment. Platform resources come from the innovation network, and intermediaries should continuously update and manage them. For literature and patent information, processing should reduce knowledge granularity, establish interconnections, and improve retrieval convenience [32]. Visualization technologies should display knowledge connections, and professional analysis tools (e.g., InCites, SciVal, TDA) should assist resource organization and integration to meet knowledge needs.

Conclusion

This study matches knowledge intermediaries to collaboration types and constructs a service model from the perspective of intermediary service foci. Conclusions are:

(1) Knowledge intermediary services are divided into two stages: knowledge matching and knowledge collaboration. Based on whether intermediaries precisely locate collaborators in stage one and provide knowledge transformation in stage two, four types are identified: Agent Intermediary (non-precise location, transformation), Partner Intermediary (precise location, transformation), Locator Intermediary (precise location, no transformation), and Connector Intermediary (non-precise location, no transformation).

(2) A knowledge collaboration model is constructed based on the new product development process. Lead users provide need knowledge during idea generation to stimulate concepts and preliminary designs. Universities/research institutions provide bottleneck-breaking knowledge during research. Competitors collaborate during development to produce prototypes. Lead users provide experience and improvement knowledge during prototype testing. Suppliers collaborate during pre-production to design processes and improve products.

(3) Combining intermediary service foci with collaboration characteristics, intermediaries are matched to collaboration types, constructing a service model for enterprise new product development. Agent Intermediaries serve lead user collaboration by mobilizing participation and transforming user knowledge. Partner Intermediaries serve university/research institution collaboration by precisely locating partners and translating academic knowledge. Connector Intermediaries serve competitor collaboration by collecting partner information and providing IP consulting. Locator Intermediaries serve supplier collaboration by precisely locating suppliers and providing technical consulting.

Limitations: (1) The matching process is based on theoretical exploration and requires case study validation; (2) The study discusses intermediary service processes but insufficiently examines core enterprise capability requirements. Future research should explore what capabilities core enterprises need to effectively utilize different intermediary services.

References

[1] CHESBROUGH H W. Open innovation: the new imperative for creating and profiting from technology[M]. Boston: Harvard Business School Press, 2003: 56-72.
[2] HOWELLS J. Intermediation and the role of intermediaries in innovation[J]. Research policy, 2006, 35(5): 715-728.
[3] LI M. Enlightenment of Haier' s open innovation on the development of new R&D institutions[J]. Science and Technology Management Research, 2017(17): 124-130.
[4] XIA E, ZHAO X. Research on influencing factors of network crowdsourcing participants' behavior: an empirical study based on Xiaomi' s network crowdsourcing community[J]. R&D Management, 2017, 29(1): 10-21.
[5] LI W, XIANG Y, GU G. Research on the functions of innovation intermediaries in the open innovation process: a case study of InnoCentive[J]. Science of Science and Management of S.& T., 2012(4): 54-59.
[6] COLOMBO G, DELL'ERA C, FRATTINI F. Exploring the contribution of innovation intermediaries to the new product development (NPD) process: a typology and an empirical study[J]. R&D management, 2015, 45(2): 126-146.
[7] LIN M, WEI J. The impact of innovation intermediary on knowledge transfer[J]. Physica A: statistical mechanics and its applications, 2018, 502: 21-28.
[8] LI W, GENG L, MEI Q, et al. Research on the service model of knowledge intermediaries in the entrepreneurial process of technology-based startups[J]. China Science and Technology Forum, 2017(9): 78-85.
[9] CHEN J, QI G, ZHOU R. Construction and evolution of innovation intermediary capabilities based on open innovation platforms: a case study of Zhongyanwang[J]. China Science and Technology Forum, 2018(10): 62-72.
[10] SUTTHIJAKRA S, INTARAKUMNERD P. Role and capabilities of intermediaries in university-industry linkages: a case of hard disk drive industry in

Thailand[J]. Science, technology and society, 2015, 20(2): 182-203.
[11] STRAMBACH S, SURMEIER A. From standard takers to standard makers? the role of knowledge-intensive intermediaries in setting global sustainability standards[J]. Global networks, 2018, 18(2): 352-373.
[12] KOKSHAGINA O, LEMASSON P, BORIES F. Fast-connecting search practices: on the role of open innovation intermediary to accelerate the absorptive capacity[J]. Technological forecasting and social change, 2017, 120: 232-239.
[13] RANDHAWA K, JOSSERAND E, SCHWEITZER J, et al. Knowledge collaboration between organizations and online communities: the role of open innovation intermediaries[J]. Journal of knowledge management, 2017, 21(6): 1293-1318.
[14] DESILVA M, HOWELLS J, MEYER M. Innovation intermediaries and collaboration: Knowledge-based practices and internal value creation[J]. Research policy, 2018, 47(1): 70-87.
[15] FARAJ S, JARVENPAA L, MAJCHRZAK A. Knowledge collaboration in online communities[J]. 2011, 22(5): 1224-1239.
[16] CHIAMBARETTO P, MASSE D, MIRIC N. "All for one and one for all?" –Knowledge broker roles in managing tensions of internal coopetition: the Ubisoft case[J]. Research policy, 2019, 48(3): 584-600.
[17] TSENG S M. A study on customer, supplier, and competitor knowledge using the knowledge chain model[J]. International journal of information management, 2009, 29(6): 488-496.
[18] UN C A, ASAKAWA K. Types of R&D collaborations and process innovation: the benefit of collaborating upstream in the knowledge chain[J]. Journal of product innovation management, 2015, 32(1): 138-153.
[19] GUTSTEIN A, BREM A. Lead user projects in practice-results from an analysis on an open innovation accelerator[J]. International journal of innovation and technology management, 2018, 15(2): 185-215.
[20] WANG N, ZHANG S, CHEN J. Lead user research: concept, measurement and influencing factors[J]. Science Research Management, 2019(1): 170-177.
[21] LYU L, WU W, HU H, et al. An evolving regional innovation network: collaboration among industry, university, and research institution in China' s first technology hub[J]. The journal of technology transfer, 2019, 44(3): 659-680.
[22] SMETS L P M, LANGERAK F, TATIKONDA M V. Collaboration between competitors' NPD teams: in search of effective modes of management control[J]. R&D management, 2016, 46(S1): 244-260.
[23] NAJAFI-TAVANI S, NAJAFI-TAVANI Z, NAUDE P, et al. How collaborative innovation networks affect new product performance: product innovation capability, process innovation capability, and absorptive capacity[J]. Industrial marketing management, 2018, 73: 193-205.
[24] PATRUCCO A S, LUZZINI D, MORETTO A, et al. Attraction in buyer-supplier relationships: improving supply network performance through purchasing recognition and proficient collaboration initiation[J]. Business process management journal, 2019, 25(2): 347-367.
[25] KOEN P, AJAMIAN G, BURKART R, et al. Providing clarity and a common language to the "fuzzy front end" [J]. Research-technology management,

2001, 44(2): 46-55.
[26] COOPER R G. The new product process: a decision guide for management[J]. Journal of marketing management, 1988, 3(3): 238-255.
[27] WANG Z, HUANG R, ZHENG X, et al. Research on multi-granularity integrated knowledge services in digital libraries[J]. Journal of the China Society for Scientific and Technical Information, 2019, 38(2): 143-158.
[28] WANG X, XI Y, XIE J. Research on knowledge transfer models based on regional innovation systems[J]. Library and Information Service, 2017, 61(17): 13-20.
[29] YUAN X, YANG S. Knowledge creation in online user innovation communities: research review and theoretical analysis framework[J]. Information Science, 2017, 35(7): 162-169.
[30] AGAN Y, ACAR M F, ERDOGAN E. Knowledge management, supplier integration, and new product development[J]. Knowledge management research & practice, 2018, 16(1): 105-117.
[31] ZHOU W, CHEN L, DENG W, et al. Process model of value co-creation among entrepreneurial platforms, entrepreneurs and consumers: the case of Xiaomi[J]. Management Review, 2019, 31(4): 283-292.
[32] LICHTENTHALER U, ERNST H. Attitudes to externally organising knowledge management tasks: a review, reconsideration and extension of the NIH syndrome[J]. R&D management, 2006, 36(4): 367-386.

Author Contributions:
Cai Jiaming: Conducted research and wrote the paper;
Zhao Shukuan: Proposed research ideas and determined the framework;
Zhang Bochen: Conducted research and revised the paper.

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