CONSTRUCTING THE INNOVATION-DRIVEN KNOWLEDGE SERVICE ECOSYSTEM MODEL OF THINK TANKS

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Abstract - The innovation-driven development theory might help to build an innovative knowledge service ecosystem of think tanks. This paper proposes a conceptual model of the innovation-driven knowledge service ecosystem of think tanks based on a literature review. The model's elements are derived from ecosystem theory, while the knowledge service ecosystem model of think tanks is constructed by applying innovation-driven development theory. The construction of the model not only provides a reference for the sustainable and healthy development of knowledge services of think tanks, but it also provides a new perspective to researchers interested in innovation at knowledge services of think tanks.

Keywords - Think Tanks, Knowledge Service Ecosystem, Innovation-Driven Development, Knowledge Service Value Chain, Human Capital

I. INTRODUCTION

A think tank is a policy research and advisory body composed of experts with clear research directions and multi-disciplinary backgrounds. Based on the acquisition, development, utilization, and innovation of knowledge, a think tank could provide policymakers with theories, strategies, methods, and ideas for dealing with complex issues[1]. A think tank is a significant knowledge source for governments to govern scientifically and supplies policy knowledge to the public[2]. That is why a think tank qualifies to be a knowledge service organization.

Current research on knowledge ecosystems mainly focuses on the concepts, theoretical systems, and their applications. J. Robertson[3]from the perspective of criticalparticipants and through case analysis of the University of Cape Town, proposes that the knowledge ecosystem is a complex and multifaceted system. The study indicates that the actors of a knowledge ecosystem are interdependent but heterogeneous knowledge-intensive organizations that have common interests in the process of creating, exploring and using the shared knowledge base for the common interests of all participants, thus, actors of knowledge ecosystems coevolve. For example, a case study of Cambridge biotechnology company shows how a knowledge ecology includes organizations that store and retrieve information and manage the general flow of information in multiple formats[4]. In general, the principal actors of a knowledge ecosystem consist of for-profit firms, universities and other public and private specialist research organizations that collectively exhibit a division of laborin the production of knowledge[4].Therefore, a knowledge ecosystem is an open and dynamic system. Knowledge resources form such an ecosystem, knowledge service activities, knowledge innovation activities and their exchange and cooperation environment in a specific time and space range, with the help of knowledge flow, value flow, material flow and other functions[5].

Service ecosystems are relatively self-contained, self-adjusting systems, resource – integrating factors connected by shared institutional arrangements and mutual value creation through service exchange[6].It originates from the business ecosystem, service-leading logic and service system. The core idea of a service ecosystem is that participants interact with each other through the integration of resources and institutional constraints, and then create value together under specific circumstances[7].Meanwhile, it can increase the level of actor commitment, participation in the co-creation process, support for public service, legitimacy, involvement in reciprocal service, sociability with other citizens, and communication[8]. P. Frow et al.[9] construct the conceptual framework of well-being in a service ecosystem, drawing on four meta-theoretical foundations of S-D logic: resources' integration, resources' density, practices and institutions, point out that service ecosystems consist of three levels of aggregation.

There is little research on the knowledge service ecosystem of think tanks(KSETT)[1]. The existing relevant research mainly focuses on the concept, theoretical construction, and application of knowledge ecosystems and service ecosystems[3-9]. For example, a study examines the academic journal knowledge service ecosystem, which is an ecological service system based on the hardware equipment, software tools and environmental factors of journal publishing[10].Our paper explores how an innovation-driven KSETT could be constructed to provide a new theoretical basis for the research on the KSETT. Our model aims to improve the innovativeness and service capacities of the KSETT.

Through an in-depth literature review, we put forward the concept and elements of the KSETT.

The rest of this paper is structured as follows. Section 2 presents an overview of the theoretical foundations, followed by a section describing in detail the innovation-driven KSETT model. The paper concludes by highlighting implications for both theory and practice.

II. THEORETICAL FOUNDATIONS

1. Ecosystem theory

British plant ecologist A.G. Tansley first introduced the concept of "ecosystem" in 1935. He believed the ecosystem was an ecological functional unit in which biotic and a biotic components interact, influence and restrict each other through continuous material circulation, energy flow and information delivery within a certain time and space[11]. Sociologist A.H. Hawley introduced the concept of the ecosystem into the social science field in 1986 and defined it as an "arrangement of mutual dependencies in a population by which the whole operates as a unit and thereby maintains a viable environmental relationship"[12].

The components of the ecosystem can be divided into two categories: main and environmental factors[13]. The former factors consist of producers, consumers and decomposers, while the latter includes material, energy, climate, and substrate. The structure of an ecosystem refers to the relative order and stable state of various components in space and time, including the component structure and nutrient structure. The component structure refers to the system structure composed of different biological types and their different quantitative combinations. The nutrient structure is the food chain and food web formed by food nutrition between organisms and between producers, consumers, and decomposers, which is the main way of material circulation and energy flow[14].

Under certain time and relatively stable conditions, the structure and function of each element of the system are in a coordinated dynamic state. Therefore, the ecosystem has six important characteristics[15]. The first one is integrity. An ecosystem is a holistic functional unit with organisms as the main bodies. It presents unified integrity in their mode of existence, goals and functions, ensuring stable network linkages among the elements. The second characteristic is the hierarchy. An ecosystem is a complex multi-level system, because the life forms in the ecosystem have many different levels, from an individual, population, and community to an ecosystem. The third characteristic is openness, referring to an ecosystem being an open thermodynamic system. In other terms, it needs to continuously absorb energy and materials from the environment and then output them to the environment after processing and transforming. The exchange of material and energy between the main elements and the environment is an ongoing and dynamic change. The fourth characteristic is stability. An ecosystem can self-sustain and self-through positive and negative feedback received from interacting and transforming with its environment. It can maintain or restore its structure and function relatively stable. The fifth characteristic is evolvability. Organic organisms constantly adapt to environmental changes and transform the environment in various ways in favour of organisms. That is why an ecosystem shows long-term adaptability to environmental changes. The final characteristic is functionality. An ecosystem has clear goals. The goals can be realized through various functional flows, such as material flow, energy flow, or information flow.

2. Innovation-driven development theory

Michael Porter, an American scholar, introduced the innovation-driven development theory in 1990. He believed that a country's economic development goes through four stages: production-factor-driven, demand-factor-driven, innovation-factor-driven, and wealth-factor-driven[16]. These different stages show the maturity of an economy. Innovation-driven development might be described as[16]: an economy based on the production, distribution, and use of knowledge and information. In other words, it is a knowledge economy using knowledge as its production factor, which is created by human intelligence. Thus, the main economic activities consist of the possession, allocation, production, distribution, and consumption of intellectual resources[17]. Think tanks are typical knowledge-intensive organizations because their most significant characteristic is their rich intellectual resources.

We apply the ecosystem theory to the KSETT in the next section. In this paper, the KSETT includes the component and nutrition structures, showing the key characteristics identified in the literature review. Then, we use the innovation-driven development theory to construct an innovation-driven KSETT model.

III. KNOWLEDGE SERVICE ECOSYSTEM OF THINK TANKS

From the perspective of ecology, this paper considers a KSETT as a composition of interdependent but heterogeneous think tanks, clients, the public and the external environment[13]. It is a system that establishes links and provides knowledge services through the transformation of information and knowledge among think tanks, clients, and the public. The ecosystem has the characteristics of integrity, hierarchy, openness, stability, evolvability, and functionality as described below.

The system composition is based on main and environmental factors.

1. Main factor

The KSETT concept considers the think tanks as the service subject, the clients as the service object, and

the public as the participants. These main factors are all interconnected and each has a different functional role in the system, thus reaching beyond the capabilities of any single organization or individual[3]. Think tanks meet clients' needs by producing knowledge services, establishing close ties with clients and the public using various service methods, delivering knowledge results, and increasing their influence[18]. As suppliers of knowledge services, think tanks are producers of the knowledge service ecosystem. Clients with different knowledge service needs entrust think tanks to provide them. As the beneficiaries of knowledge service, clients are consumers of the knowledge service ecosystem. The public benefit from think tanks'outputs through various forms[19, 20], however, they also deliver knowledge and technology to think tanks. They are the decomposers of the knowledge service ecosystem.

2. Environmental factor

A knowledge service ecosystem helps to collaboratively combine all knowledge into a shared knowledge base[3]. Knowledge resources, such as knowledge, technology, methods, and tools, are material elements of the knowledge service ecosystem [8], they are stored in the public knowledge bases and used to communicate with the external environment. Intellectual resources include theoretical resources, intangible resources (such as learning ability), tangible resources (such as machines), and people who have innovative intelligence[21]. Therefore, intellectual resources such as ability, skills, and experience form the energy elements of the knowledge service ecosystem. Service subjects, service objects, and participants cannot exist without the external environment. They benefit from the nutrition and support of the external environment. Organizations rely on relationships and related entities, which constitute the embedded interactive environment in which it exists. The political, economic, social, and technical environment constitute the external environment for think tanks, clients, and the public to coexist[22]. Therefore, the environmental factor is a key substrate element of the knowledge service ecosystem.

The system structure can be divided into component and nutrient structures.

1. Component structure

In a KSETT, think tanks attract resources and clients to create cooperative networks[3], and rely on each other. Knowledge and intellectual resources and political, economic, social, and technological environment constitute the knowledge service environment. In the knowledge service environment, think tanks, clients, and the public communicate with each other and create value together to form a knowledge service network[8]. Therefore, think tanks, clients, the public, and their combinations constitute the component structure of the KSETT.

2. Nutrient structure

The KSETT forms a knowledge service value chain by bringing together think tank production, client consumption, and the public decomposition, resulting in an inseparable whole. In an ecosystem's operation, all service subjects, service objects, and participants are distributed in the knowledge service value chain. They jointly carry out knowledge sharing and exchange activities and create value by matching supply and demand. By doing so, they provide a strong guarantee for the development of high-quality knowledge services of think tanks[23]. Therefore, the knowledge service value chain is the nutrient structure of the KSETT and the primary way for the circulation of knowledge and intellectual resources.

Our literature review identified the six key characteristics of KSETT are summarized below[15].

1. Integrity

The KSETT establishes a stable network among the think tanks, the clients, and the public. These main factors produce complementary, interdependent, collaborative, and mutually beneficial innovations[3].Hence, the KSETT is instrumental in developing consistent goals and values that result in sharing knowledge to produce high-quality knowledge service results of think tanks.

2. Hierarchy

The KSETT is a complex multi-level system composed of service subjects, service objects, participants, and knowledge service environment. Each level is embedded and connected[7], and different groups interact with each other. The whole ecosystem plays the role of "1 + 1 > 2" in the process of collaborative innovation at all levels.

3. Openness

In the KSETT, the think tanks absorb knowledge resources and intellectual resources from the external environment, realize exchanges with the environment, and carry out continuous knowledge service innovation activities. Openness allows the KSETT to handle dynamic changes in the competition and overcome market pressures[24]. This characteristic facilitates updating the ecosystem's mechanisms and reengineering the think tanks' processes.

4. Stability

The KSETT can maintain its own relatively stable state. Although the external environment is constantly changing, the structure and function of the system are in a relatively stable state because of the service subjects' autonomy[5]to the environment, and regulation of service objects, participants as well as with the environment, so that the normal operation of the entire ecosystem can be maintained.

5. Evolvability

The KSETT can integrate, build, and reconfigure internal and external competencies to address rapidly changing environment. The high-quality knowledge service achievements of think tanks need to mobilize the participation of a broaderrange of service subjects. By constantly improving evolutionary ability and exerting influence, the whole ecosystem is promoted to adapt to the environment through internal and external coordination[15].

6. Functionality

The complex relationship among service subjects, service objects, participants, and their external environment is realized through various flows[25]. It provides knowledge services to clients and the public through the knowledge service value chain[18]. It plays the functions of knowledge resource circulation, intellectual resource flow and knowledge service delivery. Finally, it maintains the sustainable development of think tanks.

IV. CONSTRUCTIONOF THE INNOVATION-DRIVEN KNOWLEDGE SERVICE ECOSYSTEM MODEL OF THINK TANKS

Based on the ecosystem and innovation-driven development theories, we construct an innovation-driven KSETT model as shown in Figure 1. The model's component structure is composed of think tanks, clients, the public, knowledge resources, intellectual resources, the public knowledge bases and the external environment. Knowledge resources circulate and intellectual resources flow among think tanks, clients, and the public. These movements form a knowledge service value chain of think tanks, indicating the nutritional structure. The solid line box represents the service subject of the KSETT, while the solid line circle represents the service object of the KSETT. The solid line polygon represents the participants of the KSETT. The cylinder box represents the public knowledge bases of the KSETT. Finally, the dotted line box represents the boundary of the KSETT from the external environment, including the innovation-driven human capital, political, economic, social, and technological environment. The hollow arrow in Figure 1 indicates human capital, the core element of innovation-driven development. After entering KSETT, human capital can be divided into knowledge and intellectual resources. These resources allow the sustainable and healthy development of the whole ecosystem. The striped two-way arrows indicate the intellectual resources, which can flow among think tanks, clients, the public, and the external environment after entering KSETT. The solid two-way arrows indicate the knowledge resources, which can circulate among think tanks, clients, the public, and the public knowledge bases, or circulate between the public knowledge bases and the external environment after entering KSETT.

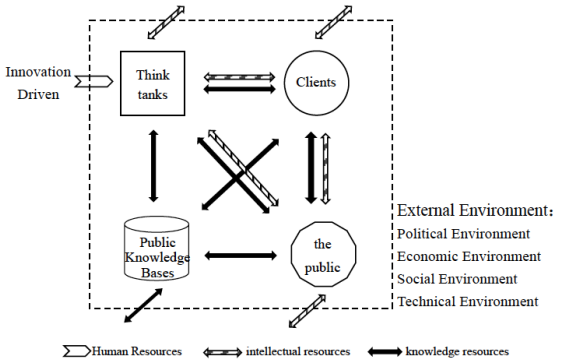


Figure 1: Model of innovation-driven KSETT

In Fig. 1, the model has a clear structure, composed of think tanks, clients, the public, the public knowledge bases, and the external environment. Various think tanks are service subjects, clients are service objects, and the public are participants, the ecosystem has hierarchy characteristics. Based on the innovation-driven development theory, human capital is the core element of innovation-driven development. Therefore, human capital is the driving force of the KSETT and drives the sustainable development of KSETT. Human capital continuously flows from the external environment to think tanks and is decomposed into knowledge and intellectual resources in the knowledge service activities of think tanks. Think tanks interact with clients and the public through the circulation of knowledge resources and the flow of intellectual resources, forming a knowledge service value chain, thus, theKSETT has a nutritional structure. Through the knowledge service value chain, think tanks realize the functions of knowledge resource circulation, intellectual resource flow and knowledge service delivery, the ecosystem has functionality characteristics. At the same time, think tanks take advantage of the flow of intellectual resources among clients, the public and the external environment to achieve the possession, allocation and use of intellectual resources, so as to maintain a stable network connection with clients and the public.In the meanwhile, think tanks through continuous interaction and mutual adaptation with the external environment to maintain the relative stability of the system, and through internal and external coordination to promote the adaptive evolution of the entire ecosystem, thus, the ecosystem has the characteristics of integrity, openness, stability and evolvability.

V. CONCLUSION

Deriving from the ecosystem and innovation-driven development theories, we propose a conceptual model to study the KSETT. Our model argues that human capital is the driving force of the innovation-driven KSETT and defines the concept and elements of the KSETT. By doing so, the paper extends the unit of analysis of the innovation-driven development

theory from general industrial organizations to knowledge-intensive organizations. Further, the study provides a reference model for policymakers and managers of think tanks who are interested in the sustainable and innovative development of their KSETT.

REFERENCES

[1] J. Shen, W. J. Cai, Y. Bi. "The status, hot spots and frontier in think tank research, " Information studies: Theory & application. 43(12): 33-41,2020.

[2] J. Shen, J. X. Yang. "Data-driven Process Optimization of Think Tanks' Knowledge Service, " Documentation, Information & Knowledge. 38(4): 14-24,2021.

[3] J. Robertson. "Competition in Knowledge Ecosystems: A Theory Elaboration Approach Using a Case Study, " Sustainability. 12(18): 1-20,2020.

[4] T. Papaioannou, D. Wield, J. Chataway. "Knowledge ecologies and ecosystems? An empirically grounded reflection on recent developments in innovation systems theory, " Environment & Planning C Government & Policy. 27(2): 319-339,2009.

[5] Z. L. Sun, H. Q. Li. "Research on the Theory of Knowledge Ecological System, " Library & Information. (5): 22-27+58,2008.

[6] S. L. Vargo, R. F. Lusch. "Institutions and axioms: an extension and update of service dominant logic, " Journal of the Academy of Marketing Science. 44(1): 5-23,2016.

[7] K. R. Linghu, Z. Q. Jian, L. Li. "Service Ecosystem: Origin, Core Viewpoints and Theoretical Framework, " R&D Management. 30(05): 147-158,2018.

[8] M. Petrescu. "From marketing to public value: towards a theory of public service ecosystems, " Public Management Review. 21(11): 1733-1752,2019.

[9] P. Frow, J. R. McColl-Kennedy, A. Payne, et al. "Service ecosystem well-being: conceptualization and implications for theory and practice, " European Journal of Marketing. 53(12): 2657-2691,2019.

[10] Q. Wu. "Research on academic journal knowledge service ecosystem and its optimization strategy under the media convergence environment, " China Publishing Journal. (23): 48-51,2020.

[11] A. G. Tansley. "The use and abuse of vegetational concepts and terms, " Ecology. 16(3): 284-307,1935.

[12] H. Hawley. Human Ecology: A Theoretical Essay, 1st. Chicago:The University of Chicago Press, 1986.

[13] X. M. Cai. Ecosystem ecology. Beijing: Science Press, 2000.

[14] Y. Y. Wang. "Structure of ecosystem, " Chinese sci-tech journal database (Abstract Edition) education. (10): 36,2015.

[15] W. X. Lin. Ecology(2nd Edition). Beijing: Science Press, 2013.

[16] M. E. Porter. The competitive advantage of nations. New York: Free Press, 1990.

[17] J. W. Chu, K. Yang. "Research on the operation mechanism of government think tanks in innovation driven development, " Library Theory and Practice. (05): 54-59+83.,2018.

[18] L. Zhang, J. Shen. "Empirical research on the knowledge service mode of think tanks based on client requirement, " Library and Information Service. 64(10): 46-55,2020.

[19] D. Sucozhanay, M. Lema, S.-G. Lorena. Think Tank Groups and University Change in Ecuador; proceedings of the nternational Technology, Education and Development Conference, F, 2017.

[20] Z. Q. Zhang, N. Su. "Trends and characteristics of global think tanks and suggestion for Chinese think tank construction, " Think Tank: Theory & Practice. 1(10): 9-23,2016.

[21] Y. P. Du, Q. Wang. "An analysis of the basic concepts of intellectual resources, " Science and Technology Management Research. (12): 34-36,2006.

[22] P. H. Wang, G. Q. Li. Overseas think tanks: investigation report of think tanks in major countries in the world. Beijing: China finance and Economics Press, 2014.

[23] Y. H. Wu, H. Jiang, C. Chen. "Research on the evolution and operation mechanism of knowledge ecosystem in think tank alliance -- Taking the case of Ali Research, " Information Studies: Theory & Application. 45(01): 54-62,2022.

[24] Y. Y. Yang. "The "Six principles" of the national high-level think tank construction in the new age, " Think Tank: Theory & Practice. 3(06): 15-19,2018.

[25] S. Barile, M. Grimaldi, F. Loia, et al. "Technology, Value Co-Creation and Innovation in Service Ecosystems: Toward Sustainable Co-Innovation, " Sustainability. 12(7): 1-25,2020.

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