

Research Review of Platform Enterprise Evolution from an Ecological Perspective Based on Citespace

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Abstract: With the rapid development of Internet and new technology, "platformization" has become a new trend of enterprise organization. The rise of Google, Amazon, Alibaba, JD and other platforms has different characteristics, development speed and scale from traditional enterprises, and their development and evolution path has attracted academic attention. Combined with Citespace and content analysis method, this paper measured and described the references on the evolution of platform enterprises from 1999 to 2021 in WOS database and made a conclusion: (1) Economics and business are two hot research perspectives. (2) Case analysis and simulation analysis are hot research methods. (3) "Common enterprises in the initial stage—platform enterprises in the growth stage—platform ecology in the mature stage" are the stages of hot spot evolution. Finally, the existing references are integrated and reviewed comprehensively, and the framework model is proposed to clarify the current research status, provide ideas for future research, and put forward prospects for the shortcomings of research.

1. Introduction

In recent years, due to the unique mechanism of platform, increasingly enterprises transform into platform enterprises[1]. Under the penetration of "Internet+", "platformization" enables enterprises to improve the efficiency of resource allocation and create more value, making it the first choice of enterprise organization mode. After entering the 21st century, the Internet platform gradually becomes mature, attracting the attention of all kinds of scholars and becoming an emerging field of academia. For example, mcintyre and Srinivasan summarized platform research from the perspectives of organizational economics, technology management and strategic management[2]. Although Facin et al. summarized the evolution process of platform conception[3], there is no research review of the evolution path of platform enterprises.

Every thing is developing dynamically, and the development and evolution is the result of a series of factors. To analyze the influencing factors and mechanism of platform enterprise development is of great significance to promote the health and sustainable development of platform enterprise. Based on this, this paper summarizes the current research achievements through Citespace, and points out the future research direction, providing theoretical guidance for the development of platform enterprises.

2. Related Conception

2.1 Platform and Platform Economy

Wheelwright and Clark put forward the conception of "product platform" for the first time in 1992, but Meyer's definition is most cited by scholars, who believe that a production platform is a set of subsystems and interfaces, forming a common structure that can efficiently produce and develop a large number of derivatives[4]. Platform is also a transaction intermediary, a type of bilateral market, characterized by two types of customers: buyers and sellers, whose core role is to match the "transaction" between the two parties[5]. At the end of the 20th century, researchers focused on the key words of "product development" and "innovation". However, as the platform occupies the mainstream market, the conception of it has gradually evolved. In the early 21st century, "modularity" has become a key word in platform research, which emphasizes the dual (multi-edge) market with the network effect as core. From 2005 to 2010, the platform was linked with "competition" and "strategy"; 2010-2015 combination of "management" and "performance" with platform conception; In recent years, the conception of platform has new meanings and new research topics have emerged, such as "big data" and "ecosystem", emphasizing the usage of data by platform and co-evolution with participants[6].

2.2 Ecosystem and the Evolution of Business Ecosystem

The term "Ecosystem" is a conception of biology, which compares biology with economics. Biology is defined by genes, and the chain of relationship is prey-competitor-predator. Economics is defined by "technology", and the chain of relationships is "supplier-competitor-customer". In 1993, Moore, introduced the conception of ecological system to the market enterprise activity, putting forward that the business ecosystem is a complex, self-organizational and dynamic structure system which is composed of customers, suppliers, manufacturers, labor unions, governments and other stakeholders[7-8]. In recent years, the digital economy has flourished and the ecosystem has shown a breakthrough development trend, reflecting the characteristics of the time of business development.

In the context of platforms, platform ecosystem refers to the complementary network of platforms and platforms that produces complementary products to increase value. Considering how participants conduct activities around the platform, it focuses on the platform itself or the interdependent relationship between platform initiator and platform participants[9]. Platform ecosystem is considered "semi-regulated markets" that facilitate entrepreneurial action under the coordination and guidance of platform originators[10] or as "multilateral markets" that allow transactions between different users[11]. Due to the business ecosystem theory, scholars have carried out researches on the definition, internal mechanism, application and evolution of the business ecosystem. Scholars attached great importance to the study of Evolution. Evolution is not the same as development. Evolution is a change direction, which can be from simple to complex evolution, or from complex to simple degeneration. The main mechanism is the heritable variation of organisms, their adaptation to the environment and competition between species. As one of the characteristics of ecosystem, Moore believes that ecosystem is co-evolution: it is a process in which interdependent species change in an endless cycle—the change of one species provides support and foundation for the natural selection of the change of another species[6]. Agiza believes that evolution has both positive and negative aspects. Positive evolution emphasizes reciprocity and sharing among species, while negative evolution emphasizes predation and vicious competition among species[12].

3. Research Methods and Data Sources

At present, using reference measurement software to write review articles is gradually recognized by academic circles. By combining bibliometrics, knowledge graph and content analysis, this paper proposes a relatively-complete framework to comprehensively analyze the research status, research fields and research hot-spots on the evolution path of platform enterprises. With the rapid development of information visualization technology, Citespace can calculate co-occurrence, centrality, burst and other indicators based on authors, institutions, national cooperation, keywords and citation of references in a certain research field. Research hot-spots and frontiers are sorted out and all kinds of maps are drawn. However, if you just rely on metro-logical analysis software, you can only understand the superficial information and cannot grasp the "essence", so it is essential to read specific references closely. Through detailed content analysis, you can improve the quality of Citespace reference interpretation.

WOS (Web of Science) core collection database was used as a retrieval platform to search references on the topic of "Platform Evolution" from 1985 to 2021, with a total sample size of 16,257. After that, the sample references were refined, which was restricted to three categories of economics, management and business according to the discipline category, and then refined into two categories of Article and Review according to the type. Finally, the abstract and content of these sample references were read carefully and screened again, and finally 263 foreign reference samples were obtained.

4. Knowledge Graph Analysis

4.1 Keywords Knowledge Graph Analysis

Keywords are the core of the content description of an article, and their analysis is helpful to find research frontiers and hot spots[13]. In this paper, keywords are selected in Citespace to obtain the domestic and foreign Keyword knowledge maps of the research on the evolution path of platform enterprises (Figure 1). The node where the keyword is located represents the frequency of occurrence of keywords in the sample references. The larger the node is, the more times the keyword appears. The line between nodes represents the correlation between sample keywords, and the thicker the line is, the stronger correlation they have [14].

4.1.1 Keywords Co-Occurrence Knowledge Graph

As can be seen from Figure 1, the high-frequency keywords in the international field of evolution research of platform enterprises include innovation, platform, competition, technology, strategy, ecosystem and collaboration, etc. They have been highly concerned by scholars which are divided into the following four categories in the paper: (1) Subjects: platform, enterprise, bilateral market and ecosystem, etc. (2) Driving factors: behavioral regulation, network externalities, big data, innovation, etc. (3) The main research contents: co-evolution, dynamics and framework, etc. (4) Research methods: case study, game theory, simulation analysis, etc. The above keywords occupy an important position in the network of this research field. In general, they are focusing on the platform enterprises driving force, the change of advantages and other issues.



Figure 1: Keywords co-occurrence knowledge graph

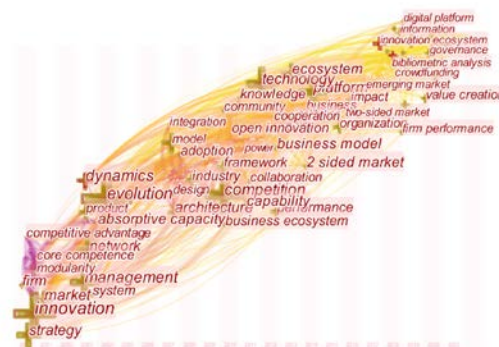


Figure 2: Keywords time zone graph

4.1.2 Keywords Time Zone Graph

Based on the knowledge graph of keyword co-occurrence, this paper draws the keywords time sequence graph of international enterprise evolution by time segment, as shown in Figure 2. The development of the research can be roughly divided into three stages: (1) The initial stage(2000-2006), which is the ideological origin of the platform. At that time, the conception of business ecosystem and platform ecosystem was just introduced, but the research was vague and the number of papers was few. (2) Stable transition stage(2007-2013): Scholars began to gradually research the platform enterprise evolution path problems from a strategic and tactical perspective, such as cooperation, competition, ability and knowledge, but the introduction of Internet and other technologies has begun to push the research on platform evolution development towards a new trend, which is not mature enough to open up a new research direction. (3) Development stage(2014-Now): As the big data, cloud computing and Internet technology become more mature, how to build a platform innovation ecosystem in the process of evolution, how to bring value to create a network effect, how co-evolute with business partners, how the algorithm of big data will bring new external environment, what changes will the algorithms of big data bring, and what impact will the new external environment such as government regulation have on the platform. These problems are widely valued by scholars worldwide.

4.2 Knowledge Graph Analysis of Highly Cited References

The cited references are the references of the cited sample references. By analyzing it, we can know the content, flow of direction and change process of current and past reference research. In this paper, Citespace was used to select the option of reference, and the knowledge map of highly cited foreign references was obtained through Pathfinder path (Figure 3). In order to display the

information in the paper more clearly, this paper sorted out the references with high citation frequency and emergent value. Table 1 is sorted by the time series of reference emergence, including the top 10 cited references.



Figure 3: Cited reference knowledge graph

Table 1: High-cited/burst references information

No.	Cited references	Year	Burst	Begin	End	Cited times
1	Open Platform Strategies and Innovation: Granting Access vs. Devolving Control[15]	2010	3.18	2012	2015	/
2	Platform Envelopment[16]	2011	3.82	2014	2016	/
3	Platform Evolution: Co-evolution of Platform Architecture, Governance, and Environmental Dynamics[17]	2010	3.54	2014	2015	/
4	Entry into Platform-Based Markets[18]	2012	3.29	2014	2017	/
5	Industry Platforms and Ecosystem Innovation[19]	2014	6.61	2016	2019	24
6	Bridging Differing Perspectives on Technological Platforms: Toward an Integrative Framework[20]	2014	6.05	2016	2019	22
7	Architectural Leverage: Putting Platforms in Context[21]	2014	3.25	2016	2019	12
8	Platform Competition: Strategic Trade-offs in Platform Markets[11]	2013	4.4	2017	2018	10
9	Technology Ecosystem Governance[22]	2014	3.16	2017	2019	10
10	Networks, Platforms and Strategy: Emerging Views and Next Steps[23]	2017	4.83	2019	2021	19
11	The Digital Platform: A Research Agenda[24]	2018	4.73	2019	2021	13
12	Towards a Theory of Ecosystems[25]	2018	3.99	2019	2021	11
13	Ecosystem as Structure: An Actionable Construct for Strategy[26]	2017	3.48	2019	2021	11
14	Platform Revolution: How Networked Markets are Transforming the Economy-and how to Make them Work for you	2016	3.44	2019	2021	21

According to the time span of the start year and end year of cited high-burst references in Table 1, this paper subdivides them into 3 time periods: stage 1 (references 1-4, end year around 2017), Stage 2 (references 5-9, end year around 2019) and stage 3 (references 10-14, all of which are the

latest hot topics). These were discovered through close reading of the references:

From the perspective of content, technology and innovation have always been the focus of the evolution of platform enterprises: Reference 1 studies the different impacts of two completely different technology platform opening approaches on innovation[15]. Reference 5 combines the industry platforms to show how the internal and external innovation management, the response to technological and market disruptions of platform enterprises changed over time[19]. Reference 6 deduces a model that emphasizes the importance of platform innovation and competition[20]. Reference 7 takes "production, innovation and transaction" as the three levers to explain how the platform ecosystem combines these three aspects[21]. Reference 9 puts forward technology platform strategy, which provides rich contributions to platform participants[22]. Reference 11 discusses the changes that digital embedded platform will bring to the evolution of platform enterprises[24]. In addition, network effect is also the focus of platform evolution: Reference 2 puts forward a platform envelope strategy, the core idea of which is to make use of network effects that previously protected incumbents[16]. Reference 4 studies the importance of network effect, platform quality and consumer expectations to the success of platform market entrants[18]. Reference 10 focuses on the relative influence of network effect and platform quality in the process of competition, and how the platform will evolve after gaining competitive advantage[23].

From the perspective of time, ecosystem strategy has gradually received more and more attention from scholars on the evolution of platform enterprises. In the first stage, reference 3 only proposes a simple framework for understanding platform-based ecosystems and discusses five research issues[17]. In the third stage, reference 12 finds that the modularization of the platform made the emergence of the ecosystem possible, and further studies on it[25]. Reference 13 conceptualizes ecosystem with the method of structuralism and provides the relationship between ecosystem and alternative structure (such as platform), contributing to the construction of platform ecosystem and providing a theoretical guidance for the evolution from enterprise platform to platform ecosystem[26]. It can be seen that business ecosystem is deepening over time in the research of the evolution of enterprise platform, and gradually combines with platform to form the research on platform ecosystem.

5. Observation and Analysis of Hot Spots in Existing References

This paper analyzes the co-occurrence and time zone of keywords, high-cited and high-burst international references to make a review. Based on the research perspective, research method and evolution stage, the above measurement results are summarized accordingly in order to put forward a research model(Figure 4) on the evolution path of enterprise platform from an ecological perspective and provide theoretical guidance for future research.

From the perspective of economics, scholars have conducted extensive studies on the network effect and value co-creation, because the network effect and multilateral markets are the basic characteristics of platforms[20]. From the perspective of business, the transformation from competitive advantage to ecological advantage is the most obvious feature of advantage change during platform evolution, which has been summarized in the references above. In addition, from the perspective of system dynamics (entropy theory) and technology management (engineering design of platform[27]), studies have also been carried out, but they have not been widely paid attention to. So the further research needs to contact different perspectives and carry out theoretical dialogue and integration under different perspectives.

From the perspective of research methods, most scholars adopt simple narrative and grounded theory based case qualitative research. Some scholars also conduct simulation research and analysis on evolution from the perspective of system dynamics. However, few scholars start from the

establishment of economic and econometric models. For the shortcomings of research methods, further research needs to improve the theoretical framework, accumulate data, increase quantitative analysis, turn quality into quantity and obtain core driving forces in the evolution process, which can provide platform enterprises with more intuitive tactical and strategic guidance for their references. The proposed research methods include: obtaining the dimensions in the evolutionary path through grounded theory, using econometric model to verify the consistency of "quantity and quality", and using multiple methods to improve the research level of the paper.

Platform ecology is the development goal of platform enterprises, which derives from the business ecosystem. Moore, the founder of the business ecosystem theory, holds that the business ecosystem generally goes through four stages: birth, expansion, leadership and regeneration/extinction[7-8]. It is similar to the life cycle theory, so for the evolution of enterprise platform, most scholars use the stage paradigm model "start-up stage → growth stage → maturity stage" as the perspective of the research on the evolution path of platform enterprises. It is referred to the platform enterprise evolution path in generalized meaning. A few scholars start from the platform evolution in narrowed meaning(as shown in Figure 5), analyzing the evolution path of the "bottleneck-strategy-outcome" paradigm for enterprises that have established platform ecology. For a form of platform as the target of an enterprise, "the ordinary" belongs to its initial period, meaning ready to grow; "The platform" belongs to its "growth stage", has formed a platform but not mature; "The ecological" belongs to its "mature stage", which is the highest goal of platform enterprises at present. Therefore, for the research on the current platform evolution path, "ordinary enterprises in the initial stage -- platform enterprises in the growth stage -- platform ecology in the mature stage" is the hot evolution stage. However, there are some shortcomings. Since it is a study about evolution, almost no scholars start from the opposite side and make a positive and negative comparison to elaborate the reasons for the failure of the evolution of platform enterprises, which may provide more profound management enlightenment. For example, Reisinger believes that the network effect is not only positive, but also negative. In some platforms, the supply/demand side increases, but the scale of demand/supply side decreases, thus establishing a unique platform enterprise competition model with negative network effect[28].

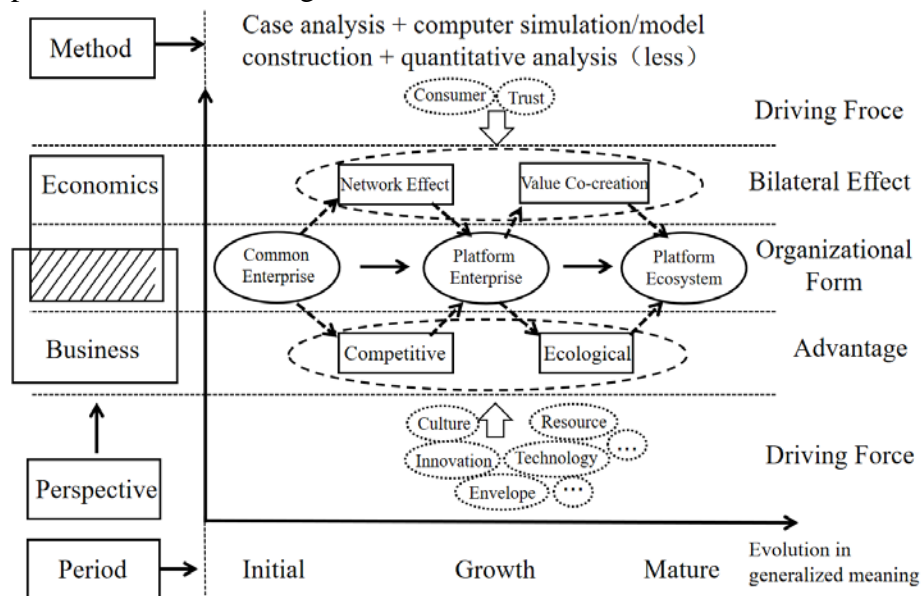


Figure 4: Platform enterprise evolution path model in generalized meaning

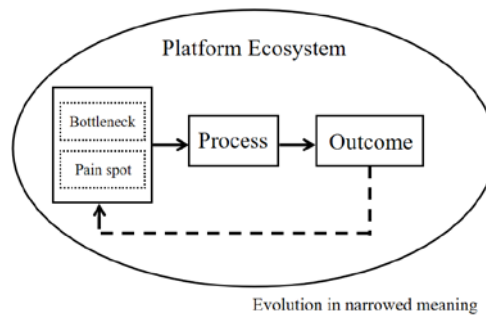


Figure 5: Platform enterprise evolution path in narrowed meaning

6. Conclusion and Future Prospect

In this paper, Citespace knowledge Map is used as the main instrument, and content analysis method is used as the auxiliary to analyze the international references. We sorted out the research frontiers and hot issues on the evolution path of platform enterprises from an ecological perspective: Economics and business are two hot research perspectives. The network effect and value co-creation are hot spots in economics, while the construction of competitive advantage and ecological advantage are hot spots in business. Case analysis and simulation analysis are hot research methods. "Common enterprises in the initial stage—platform enterprises in the growth stage—platform ecology in the mature stage" are the stages of hot spot evolution. Most importantly, this paper integrates the research perspective, research stage and research method to provide a relatively-complete model of platform enterprise evolution path (narrowed model can be included in the generalized model), providing theoretical ideas for future research.

But the platform enterprise evolution path under the ecological perspective, there are still some problems to be further studied: First, the evolution path of the study must be combined with platform governance and value creation, because nowadays many enterprises have realized the value creation and value co-creation, but by means of damaging market fairness. For instance, the "platform envelopment" strategy is feasible from the perspective of the enterprise if it can handle the cost and management problems well, but it may lead to monopolistic competition from the market as a whole, or even to complete monopoly if it is more serious, which requires perfect governance and supervision. Secondly, platform ecology is the highest goal for the development of platform enterprises, and we must also pay attention to the "gene" of platform enterprises themselves. Different platforms have different genes. If the platform genes are considered in advance, the governance of the platform can be carried out in advance to avoid the situation of "Better late than never". Finally, it is expected that other scholars continue to carry out researches to enrich the current research results: whether there is a new platform model after the formation of "platform ecology", whether there is a better strategic model than platform ecology, etc.

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