The Business Ecosystem Collaboration Mechanism Driven by Big Data and the Optimization of Enterprise Value Network

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Abstract: In the era of digital economy, big data technology has become the core driving force for the synergy of business ecosystems and the optimization of enterprise value networks. This paper conducts an in-depth theoretical analysis of the formation logic of the business ecosystem synergy mechanism under the influence of big data, and explores its path of effect on the optimization of enterprise value networks. The research finds that big data reconfigures the mode of information interaction, optimizes the logic of resource allocation, and reshapes the paradigm of value creation, promoting the evolution of the business ecosystem towards a dynamic collaborative network, and prompting the enterprise value network to upgrade from a linear chain to a three-dimensional network. This paper proposes that enterprises need to build a data-driven collaborative governance framework to achieve the continuous optimization of the value network and the systematic improvement of the ecological competitiveness.

Keywords: Big Data; Business Ecosystem; Collaborative Mechanism; Value Network Optimization; Digital Economy

1. Introduction

In today's era, the digital economy is booming at an unprecedented speed, sweeping all over the world and profoundly changing the face of the business world [1]. With the continuous penetration of digital technology, the complexity and dynamics of business ecosystem have greatly increased, showing a highly intertwined and unpredictable situation. The traditional value chain theory was born in a relatively stable business environment, and its core lies in describing the linear and one-way value transfer process between enterprises, emphasizing the independent role of individual enterprises in value creation [2]. However, under the background of digital economy, the value creation relationship between enterprises has become highly complex, which is no longer a simple linear chain, but presents nonlinear and multi-dimensional characteristics. The cooperation and competition between enterprises is no longer limited to the traditional upstream and downstream relationship, but involves many subjects across industries and fields, which makes it difficult for the traditional value chain theory to fully explain modern business phenomena [3].

As a result, value network theory appeared, which became a super-important model for us to understand the modern business world. This theory puts the customer's needs at the center, and jumps out of the old value chain box, so that people can no longer just stare at one company, but pay attention to the whole network ecosystem [4]. In value network, companies no longer create value by themselves, but realize value co-creation by cooperating with suppliers, partners, competitors and customers. This way of working together can give full play to everyone's strengths, pool resources together, and form a strong synergy, which creates much more value than a company working alone [5].

At the same time, big data technology has also made breakthrough development and become a key force to promote business change. Big data has the characteristics of mass, diversity, high speed and low value density, and enterprises can use advanced technology to capture and analyze massive heterogeneous data [6]. These data cover business operation, market dynamic changes, personalized needs of users and other aspects, providing rich data resources and technical support for business ecological cooperation. The flow and sharing of data elements broke the information barrier between enterprises and changed the way of interaction between them. Enterprises no longer only rely on limited internal information and traditional

market research, but can obtain comprehensive, accurate and real-time information through big data platforms, so as to more accurately grasp market trends and user needs [7]. At the same time, data elements reconstruct the operating logic of the value network, so that value creation is no longer limited to the enterprise itself, but extended to the entire business ecosystem, promoting deep cooperation and collaborative innovation among all subjects [8].

Therefore, it has become a topic of concern to study how big data promotes the formation of business ecosystem cooperation mechanism and optimizes enterprise's value networks. In-depth discussion on this issue will not only help enrich and improve the theory of business ecosystem cooperation and value networks, but also provide scientific guidance for enterprises, and help enterprises to better seize opportunities and meet challenges and achieve sustainable development in the digital economy era.

2. The Theoretical Foundation of Big Data and Business Ecological Synergy

2.1 The Connotation and Characteristics of Business Ecological Synergy

Business ecological synergy is a super important and dynamic concept in the current business field. It refers to the fact that all members of the ecosystem work together through resource sharing, complementary capabilities and risk sharing, and finally realize greater overall value than the sum of them alone. This process is not static, but will be constantly adjusted and evolved according to internal and external changes, characterized by being full of vitality and being able to adapt to changes.

Business ecological synergy has a series of unique core characteristics. First of all, the diversity of subjects is an important symbol. In this complex ecology, it includes suppliers, partners, competitors, customers and other different organizations. These subjects have different nature, different goals and different modes of operation, but it is this diversity that brings rich resources and diverse perspectives to collaboration. Secondly, the nonlinear relationship is an important feature. Unlike the one-way value transfer in the traditional linear relationship, the value flow in the business ecological synergy presents a multi-directional interactive model. Each subject influences and promotes each other, forming a complex value network. Finally, the symbiosis of goals embodies the essence of synergy. Each subject does not pursue the maximization of its own interests in isolation, but realizes common evolution through collaborative innovation and promotes the prosperity and development of the whole ecology.

The emergence of big data has injected new vitality into these characteristics of business ecological synergy. Data flow breaks through the limitation of organizational boundaries and expands the scope of collaboration from one part to the whole ecosystem. Data between different subjects can flow and share freely, which provides a broader space for collaboration. At the same time, the data-driven decision-making model effectively reduces the degree of information asymmetry. With the support of big data, each subject can obtain the required information more timely and accurately, and make more scientific and reasonable decisions, thus improving the stability of collaboration.

2.2 The Enabling Role of Big Data in Business Ecological Collaboration

Big data has changed the way of information exchange and provided basic support for business ecological cooperation. Specifically, big data technology can: first, improve information transparency, and eliminate information islands by collecting and integrating operational data, market data and user data of all entities in the ecosystem in real time; Second, improve the accuracy of decision-making, use machine learning algorithm to deeply mine massive data and find cooperation opportunities and risks; Third, optimize the efficiency of resource allocation, realize accurate resource allocation through data matching, and reduce the cost of cooperation; Fourth, promote the diffusion of innovation, because the data platform becomes the carrier of knowledge dissemination and creative collision, and accelerates the iterative upgrade of technology, mode and management within the ecosystem.

3. Construction of the Business Ecological Collaborative Mechanism Driven by Big Data

3.1 Data Sharing Mechanism: The Infrastructure for Collaboration

Data sharing is the premise of business ecological cooperation. Establish unified data standards and interface specifications through

big data technology, break down barriers between organizations, and form an ecological data pool. For example, blockchain technology can ensure the reliability of data sources and transmission security, while federated learning technology allows all parties to complete joint modeling without data cross-domain, thus sharing data and protecting privacy. The value of data sharing mechanism lies in: on the one hand, it reduces the cost of information acquisition, so that all participants can formulate cooperation strategies based on comprehensive data; On the other hand, it promotes knowledge spillover, and realizes the cross-organizational dissemination of technology, experience and best practices through data flow.

3.2 Intelligent Matching Mechanism: The Efficiency Engine for Collaboration

The intelligent matching mechanism realizes the accurate alignment of resources and requirements through the algorithm model. On the demand side, big data analysis can depict user portraits and predict demand trends, providing market insights for members of the ecosystem; On the supply side, the data-driven resource evaluation model energizes enterprise capabilities and finds complementary resources. For example, a supply chain collaboration platform integrates supplier capacity data, logistics data and demand data, and can dynamically adjust production plans and distribution routes to achieve accurate matching between supply and demand. The core advantage of intelligent matching mechanism lies in changing the traditional "push-type" collaboration into "pull-type" collaboration, reducing resource mismatch and waste, and improving the operational efficiency of the whole ecosystem.

3.3 Dynamic Governance Mechanism: The Guarantee System for Collaboration

The dynamic governance mechanism maintains the stability and sustainability of business ecological cooperation through rule design and institutional arrangement. Big data plays a dual role in this process: first, as a governance object, it can track the collaboration process in real time through data monitoring and find violations and risk events; Second, as a governance tool, we can optimize governance rules based on data analysis and realize the adaptive adjustment of governance model. For example, a credit scoring model can dynamically update the credit rating according to the historical cooperation data of enterprises and encourage trustworthy behavior; A collaborative performance evaluation system can quantify collaborative contributions through multidimensional data and provide a basis for benefit distribution. The key of dynamic governance mechanism is to balance the openness and controllability of ecosystem, and to prevent systemic risks while promoting innovation.

4. The Optimization Path of Enterprise Value Network Driven by Big Data

4.1 Reconstruction of Value Creation Logic: From Linear to Network

Traditional value chain theory emphasizes that value flows in one direction along a fixed chain, while value network driven by big data shows three-dimensional characteristics. With the connection of data elements, enterprises and suppliers, customers, competitors, etc. form multi-directional value interaction relationships. For example, customer data feedback can in turn promote product development, competitor data sharing can bring cooperative innovation, and supplier data integration can also optimize the flexibility of supply chain. This networked value creation mode enables enterprises to break through the limitation of a single chain, allocate resources from the perspective of the whole ecology, and maximize value creation.

4.2 Innovation of Value Distribution Mechanism: From Zero-Sum to Win-Win

Big data technology has changed the underlying logic of value distribution. In the traditional mode, value distribution usually depends on who has strong negotiation ability and who has scarcer resources, which is a bit like a zero-sum game of "you have more and I will have less". In the data-driven value network, distribution pays more attention to contribution and synergy. For example, smart contracts based on blockchain can automatically implement the allocation rules, and divide the money according to the amount of data provided by all parties in the collaboration, innovation investment and risks taken; The data asset evaluation model can also "price" enterprise data, so that data elements can participate in the distribution according to evidence. This win-win mechanism can encourage all members of the ecology to

continue to invest in cooperation and form a virtuous circle.

4.3 Expansion of Value Network Boundaries: From Closed to Open

Big data has transformed the enterprise's value network from a closed system to an open system. On the one hand, data flow makes organizational boundaries less rigid, and enterprises can integrate external resources faster and expand the scope of value networks; On the other hand, data sharing promotes knowledge spillover in the ecology, attracts more members to join the value network, and forms a three-dimensional ecology of "core enterprise-partner-user-third-party service provider". For example, by opening the API interface, platform enterprises allow third-party developers to access platform data and innovate application scenarios together, thus extending the value network to the entire industrial ecology. The open boundary of value network can gather more innovative elements and enhance the competitiveness of the whole ecology.

5. Challenges and Countermeasures: Collaborative and Optimized Practices Driven by Big Data

5.1 Challenges in Data Security and Privacy Protection

The cooperative business environment promoted by big data faces security risks like data leakage and abuse. In order to solve this problem, companies need to establish a multi-level data security system: on the technical level, encryption algorithms, access control and anonymization processing are used to protect data security; At the management level, it is necessary to formulate data classification and hierarchical management systems, and clearly stipulate who can use data and how to use it; At the legal level, it is necessary to abide by the provisions of "Data Security Law" and "Personal Information Protection Law", so as to make the collection, storage and sharing of data conform to the norms.

5.2 Challenges in Data Standards and Interface Unification

Different organizations in the ecosystem use different data standards and interfaces, which makes it difficult for data to connect with each other. In order to solve this problem, we need to promote the standardization of industry data: the government and industry associations should take the lead in formulating unified data standards and interface specifications, including data formats, transmission protocols and semantic definitions; Enterprises should also actively participate in the formulation of standards and put standard interfaces into their own systems, so as to seamlessly connect with ecological partners.

5.3 Challenges in Collaborative Culture and Organizational Transformation

The collaborative demand of big data requires enterprises to break the traditional organizational boundaries and establish an open and shared cooperative culture. To this end, enterprises need: first, reshape the organizational structure, set up an inter-departmental data governance team, and coordinate data collaboration within the ecosystem; Second, cultivate data culture and improve employees' data awareness and collaboration ability through training and incentive mechanism; Third, optimize the performance appraisal system, incorporate collaborative contribution into employee evaluation indicators, and guide behavior changes.

6. Conclusion

Big data technology is completely changing the collaboration logic of business ecosystem and the operation mode of enterprise value network. By establishing data sharing, intelligent matching and dynamic governance mechanisms, big data promotes the evolution of business ecosystems to dynamic collaborative networks; By reconstructing the logic of value creation, innovating the mechanism of value distribution and expanding the boundary of value network, big data promotes the upgrading of enterprise value network from linear chain to three-dimensional network. Future research can continue to explore: first, what are the different characteristics of big data collaboration mechanism in business ecosystems of different industries; Second, what impact will these new technologies, such as AI and blockchain, have on the collaboration mechanism after they are combined with big data? Thirdly, under the background of global value chain readjustment, how does big data promote the collaborative path of transnational business ecosystems? Enterprises need to actively embrace the changes

brought by big data and establish a collaborative governance framework driven by data, so as to achieve sustainable development in the era of digital economy.

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