

Theoretical Framework for Building the Resilience of Business Ecosystems Based on Big Data

Weixuan Tang

School of international business, Hunan University of Technology and Business, Changsha, 410205, China
1326102030@qq.com

ABSTRACT

This article focuses on the construction of business ecosystem resilience based on big data, thoroughly analyzing the connotation and characteristics of business ecosystem resilience, and elaborating on the crucial role of big data in enhancing the resilience of business ecosystems. From aspects such as the improvement of data-driven foresight ability, adaptability, collaboration ability, and innovation ability, a theoretical framework for the construction of business ecosystem resilience based on big data is constructed, and the strategies and paths for its practical application are discussed. The aim is to provide theoretical guidance for the sustainable development of business ecosystems in complex and changing environments.

Keywords: Big data; Business ecosystem; Resilience building; Theoretical framework.

1. INTRODUCTION

In the digital age, the business ecosystem is facing unprecedented complexity and uncertainty. The dynamic changes in the global political and economic structure, the rapid development of technology, the rapid iteration of consumer demand, and natural disasters have all brought great challenges to the stable operation of the business ecosystem^[1]. Resilience, as the key ability of business ecosystem to resist external shocks, maintain its own stability and achieve sustainable development, has become the focus of academic and business circles^[2]. The rise of big data technology has brought new opportunities and new means to enhance the resilience of business ecosystem. Through the collection, storage, analysis and application of big data, business ecosystem can more accurately perceive environmental changes, predict potential risks, optimize resource allocation, and enhance collaboration capabilities, thus realizing the effective construction of resilience^[3]. Therefore, it is of great theoretical and practical significance to construct the theoretical framework of resilience of business ecosystem based on big data^[4].

2. OVERVIEW OF BUSINESS ECOSYSTEM RESILIENCE

2.1 Definition of Business Ecosystem Resilience

Business ecosystem resilience refers to the ability of a business ecosystem to maintain its structural integrity and functional stability in the face of external interference and pressure, and to recover to its original state or new equilibrium state through self-repair and adaptation mechanism after being damaged^[5]. This ability is not only reflected in the system's ability to resist interference, but also in its adaptability and learning ability. Specifically, the resilience of business ecosystem includes structural stability, functional continuity, resilience and adaptability. Structural stability means that the ecosystem can still maintain a relatively complete structure after being disturbed; Functional continuity refers to the fact that the ecosystem can still maintain key ecological functions after being disturbed; Resilience refers to the speed and ability of an ecosystem to recover to its original state or new equilibrium state after being disturbed; Adaptability refers to the ability of an ecosystem to adjust its internal mechanism to adapt to changes in the external environment^[6].

2.2 Characteristics of Business Ecosystem Resilience

The resilience of business ecosystem has several characteristics: diversity, interaction, adaptability and co-evolution. Diversity is reflected in the different types of participants, risk types, business models and supporting institutions in the ecosystem, which provide the system with rich resources and coping strategies, making the system more resistant to risks

[7]. Interaction means that each participant in the ecosystem forms a complex network relationship through the exchange of material, energy and information, which promotes the dissemination of knowledge and the sharing of resources, so that the system can cope with the impact together [8]. Self-adaptability means that the ecosystem can automatically adjust its structure and function according to the changes of the external environment to adapt to the new environmental conditions [9]. Coevolution emphasizes the mutual influence and promotion among the participants in the ecosystem, and promotes the development and evolution of the system together. In the face of external shocks, this co-evolution mechanism can make the system recover faster and even upgrade.

3. THE ROLE OF BIG DATA IN BUILDING THE RESILIENCE OF BUSINESS ECOSYSTEMS

3.1 Providing Comprehensive and Accurate Information Support

Big data has the characteristics of large quantity, variety, high speed, low value density but large total amount. It can provide comprehensive, accurate and timely information to the business ecosystem. By collecting and analyzing all kinds of data inside and outside the ecosystem, enterprises can deeply understand market trends, consumer demand, competitors' dynamics and their own operating conditions, which can provide scientific basis for decision-making. For example, by analyzing social media data, e-commerce transaction data and user behavior data, enterprises can accurately grasp consumer preferences and demand changes, adjust product strategies and marketing strategies in time, and enhance market competitiveness.

3.2 Enhancing System's Forecasting Ability

The reason why big data is so diverse is that things in the real world are very complicated, so the data looks and sizes are different. Panoramic monitoring with big data can help enterprises to see more comprehensively, learn to "see the details" and improve their ability to predict the future. On the one hand, big data can display information from different angles, which is not as limited as data from a single source, so that enterprises can have a more comprehensive understanding of the innovation and business environment, and it is easier to grasp the trend of environmental changes and find possible crises. On the other hand, through big data, enterprises can more easily capture "weak" signals that traditional data can't find, so they can be more sensitive to the environment and have stronger forecasting ability. For example, Nestlé company set up a "Digital Promotion Team" to monitor the social platform in a panoramic way, and also used an automatic alarm mechanism to find the crisis, which greatly improved the company's crisis prediction ability.

3.3 Optimizing Resource Allocation and Decision-Making

Big data analysis can help our company optimize production, sales and logistics, improve efficiency and quality, and reduce costs and risks. By analyzing the production data, the company can realize the fine management and intelligent control of the production process and improve the production efficiency and product quality; By analyzing the sales data, the company can understand the sales situation in different regions and channels and optimize the sales strategy and inventory management; By analyzing the logistics data, the company can optimize the distribution route and transportation mode and reduce the logistics cost. At the same time, big data can also provide support for the company's decision-making. By comprehensively analyzing market data, competitor data and internal data, the company can make more scientific and reasonable strategic decisions and improve the accuracy and effect of decision-making.

3.4 Promoting Innovation and Collaborative Cooperation

Big data provides a lot of materials and inspiration for the innovation of business ecosystems. By analyzing and mining big data, enterprises can discover new market opportunities, develop new products and services, and innovate business models. For example, the personalized recommendation system based on big data can recommend personalized products to users according to their interests and preferences, which will not only make users more satisfied and willing to continue to use, but also help enterprises find new ways to make money. In addition, big data can also promote the cooperation of all participants in the business ecosystem. By establishing the data sharing platform, enterprises can connect data with each other, share resources, strengthen communication and collaboration with each other, and meet external challenges together to achieve a win-win situation in which everyone can benefit.

4. THE THEORETICAL FRAMEWORK FOR BUILDING THE RESILIENCE OF A BUSINESS ECOSYSTEM BASED ON BIG DATA

4.1 Enhancement of Predictive Capability through Data-driven Methods

Establish a comprehensive data collection system to connect all kinds of data sources inside and outside the ecosystem, including our internal production, sales and financial data, as well as external market data, industry data and social media data. Use various data collection tools and technologies, such as web crawlers, Application Programming Interfaces and sensors, to achieve real-time and accurate data collection. At the same time, establish a data warehouse or data lake, store and manage the collected data in a centralized way, and lay the foundation for the later data analysis.

Advanced data analysis techniques and algorithms, such as statistical analysis, machine learning and deep learning, are used to analyze the collected data in depth. Understand the basic characteristics and distribution of data through descriptive statistical analysis; Through correlation analysis and causal analysis, the internal relations and laws between data are explored; Through predictive analysis, a forecasting model is established to predict market trends, consumer demand and potential risks. For example, forecasting sales data with time series analysis method enables enterprises to prepare production and inventory in advance; Analyze social media data with sentiment analysis technology, understand consumers' attitudes towards products and brands, and find potential crisis signals in time.

Establish an evaluation index system of forecasting ability, regularly evaluate the forecasting ability of enterprises and give feedback. Evaluation indicators can include the accuracy of crisis identification, the advance time of prediction, and the sensitivity to environmental changes. According to the evaluation results, the strategy of data collection and analysis is adjusted in time, and the mechanism of improving forecasting ability is continuously optimized to ensure that enterprises can find potential crisis events in time and accurately, and provide basis for the formulation of subsequent response measures.

4.2 Enhancement of Adaptability Through Data-driven Methods

According to the analysis results of big data, make a comprehensive emergency plan. These plans should cover all possible crisis events, and clearly define emergency procedures, division of responsibilities and resource allocation schemes. At the same time, according to different crisis scenarios, formulate corresponding coping strategies and measures to ensure that enterprises can respond quickly and effectively when the crisis occurs. For example, in the case of supply chain interruption, make a list of standby suppliers and an emergency procurement plan; In view of the sudden change of market demand, flexible production adjustment scheme and marketing strategy are formulated.

Establish a real-time data monitoring system to monitor and warn key indicators in real time. By setting thresholds and early warning rules, when the data fluctuates abnormally, an early warning signal is sent to remind enterprises to take corresponding measures. For example, real-time monitoring of inventory levels, production progress, sales data and other key indicators. When the inventory is lower than the safe inventory level or the production progress is lagging behind, an early warning is issued, so that the enterprise can adjust the production and procurement plan in time.

In case of emergency, the enterprise should immediately start the emergency plan and adjust the production and management strategies according to the real-time data monitoring results. Through big data analysis, we can understand the scope and extent of the impact of the crisis, optimize the allocation of resources, and concentrate on coping with the crisis. For example, during the epidemic, enterprises can use big data analysis to understand the changes in market demand in different regions, adjust product production and distribution plans, and give priority to meeting the needs of key regions; At the same time, expand sales through online channels and reduce the impact of offline stores.

4.3 Enhancement of Collaboration Capability through Data-driven Methods

Build a data sharing platform so that all participants in the whole business ecosystem can share and exchange data. Through unified data standards and interface specifications, data consistency and interoperability are guaranteed. This data sharing platform can provide services such as data query, data download and data analysis, which is convenient for everyone to get the data information they need. For example, enterprises in the supply chain can share inventory data, production planning data, etc. through the data sharing platform, so that the supply chain can cooperate and improve efficiency and resilience.

On the basis of data sharing platform, establish a mechanism for everyone to make decisions together. Through online meetings, data analysis and discussion, all participants can communicate and cooperate and make decision-making plans

together. When making a decision, we should carefully consider everyone's interests and needs, so as to make the decision scientific and fair. For example, when the market changes, enterprises can analyze market data together with suppliers and distributors, formulate joint marketing strategies, and jointly meet market challenges.

Establish an evaluation index system for collaborative capabilities, and conduct regular evaluations and feedback on the collaborative capabilities of the business ecosystem. The evaluation indicators can include the degree of data sharing, the efficiency of collaborative decision-making, the satisfaction of partners, etc. Based on the evaluation results, promptly adjust the functions of the data sharing platform and the collaborative decision-making mechanism, continuously optimize the mechanism for enhancing collaborative capabilities, and promote deep collaborative cooperation among all participants in the business ecosystem.

4.4 Enhancement of Innovation Capacity through Data-driven Approach

Discover new market opportunities and innovations by digging deep into big data. Using data mining techniques, such as association rule mining and cluster analysis, this paper analyzes the behavior patterns and demand characteristics of consumers and finds out the potential market demand. For example, by mining e-commerce transaction data, we can find consumers' associated purchase behavior of certain goods, so that we can develop related product portfolios or value-added services.

According to the analysis results of big data, we can explore new business models and ways to make money. Combining the needs of the market and the development trend of science and technology, we will constantly innovate the form and content of products and services to create a unique competitive advantage. For example, the personalized customization model based on big data can provide users with tailor-made products and services according to their own special needs, which not only meets the various needs of users, but also opens up new market space for enterprises.

Build an innovation ecosystem around data and attract all kinds of innovation subjects to participate. By building an innovation platform, providing innovation resources and supporting policies, we will promote cooperation and exchanges among innovation subjects and stimulate innovation vitality. For example, enterprises can establish joint laboratories or innovation centers with universities and research institutions to jointly carry out R&D work related to big data and promote technological innovation and achievement transformation.

5. APPLICATION STRATEGIES FOR BUILDING RESILIENCE IN BUSINESS ECOSYSTEMS BASED ON BIG DATA

5.1 Strengthen Data Governance

Establish a complete data governance system to ensure the quality and security of data. Formulate data standards and management norms, and clarify the processes and responsibilities of data collection, storage, use and sharing. Strengthen data security management and take measures such as data encryption, access control and backup recovery to prevent data leakage and loss. At the same time, cultivate professional data management talents and improve the data management ability of enterprises.

5.2 Cultivate Big Data Talents

Intensify efforts to train and recruit big data talents, and improve the data literacy and data analysis ability of enterprise employees. Conduct internal training and external cooperation, provide employees with training courses and learning opportunities related to big data, and encourage employees to learn and master big data technology and application methods. At the same time, actively introduce big data talents with rich experience and professional skills, enrich the data team of enterprises, and provide talent support for the construction of business ecological resilience.

5.3 Promote Technological Innovation

We should continuously invest in R&D resources to promote the innovation and application of big data technology. We should pay attention to the cutting-edge technologies and development trends in the field of big data, such as artificial intelligence and blockchain, and explore the combination of these technologies and big data to provide stronger technical support for the construction of business ecosystem resilience. For example, artificial intelligence technology is used to improve the accuracy and efficiency of data analysis, and blockchain technology is used to ensure the security and trusted sharing of data.

5.4 Strengthen Cooperation and Exchange

Actively cooperate and exchange with other participants in the business ecosystem to jointly promote the application of big data in resilience construction. Through establishing strategic partnerships, participating in industry alliances, etc., strengthen data sharing and collaborative innovation among enterprises. At the same time, we should strengthen cooperation with the government, universities and research institutions, so that we can get policy support and technical guidance, and work together to create a better environment for the application of big data.

6. CONCLUSION

This paper constructs a theoretical framework of business ecosystem resilience based on big data. It explains in detail the key role and application strategy of big data in the resilience construction of business ecosystem from the aspects of data-driven foresight, adaptability, collaboration and innovation. In the current complex and changeable business environment, the business ecosystem faces many challenges and uncertainties, and improving the system resilience has become a key factor for the sustainable development of enterprises. The rise of big data technology provides new opportunities and new means for enhancing the resilience of business ecosystems. By strengthening data governance, cultivating big data talents, promoting technological innovation, and promoting cooperation and exchanges, enterprises can give full play to the advantages of big data, build a resilient business ecosystem, effectively cope with external shocks, and achieve sustained and stable development. Future research can continue to explore the application differences and effects of big data in different types of business ecosystems, and how to better combine other emerging technologies to enhance the resilience of business ecosystems.

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