Simulation Research on the Innovation Mechanism of New Retail Business Models Driven by Big Data

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Abstract: The new retail business model, which focuses on human beings, goods as the essence, and market as the foundation, promotes innovation in the new retail business model. From the perspective of big data-driven innovation in new retail business models, big data capabilities can be divided into three categories: big data acquisition capabilities to improve customer profiles, big data resource integration capabilities to integrate the reasonable allocation of upstream and downstream resources in the supply chain of new retail enterprises, and big data application capabilities to carry out personalized customization and marketing to improve customer satisfaction. Based on a basic case study, a system dynamics model was constructed to model and analyze the impact mechanism and path of big data capability on enterprise revenue and customer size under the driving force of new retail enterprise innovation driven by big data capability.

Keywords: Business model innovation; New retail; Big data

1 Introduction

The rise of Industrial Revolution 4.0 signifies that information technology is increasingly becoming a driving force for industrial change, and this era has arrived. Digitalization has not only become an inevitable trend in industrial development, but also drives the transformation of new retail business models. In the process of sustainable and dynamic development of new retail business models, digitization is the inevitable path. In the current period of rapid development of the digital economy, new generation digital technologies, such as big data, cloud computing, blockchain, and the Internet of Things, based on data, are driving innovation in new retail business models. The transformation of the new retail business model towards digitalization has also brought a turning point for many enterprises[1]. However, some new retail enterprises have not fully explored the role of data driving force, resulting in long-term losses and ultimately had to go bankrupt. Digital transformation is not only the use of digital technology in the new retail business model of enterprises, but also the infiltration of digital technology into various organizations in the new retail business model of enterprises, using digital technology to promote the progress and development of business models. The core essence of the innovation of the new retail business model lies in the digital promotion of business model innovation[2]. In the digital era, enterprises need to strengthen the construction of digital capabilities while emphasizing strategic flexibility when innovating their business models[3]. Digital technology should penetrate into various organizational levels of business model innovation to better adapt to the constantly changing environment and improve performance[4]. As Xiaofang Zhu [5] believes, innovation in the new retail business model directly or indirectly affects enterprise

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performance by incorporating digital technology into the components of the new retail business model. Weihong Xie [6]believes that the important characteristic of digital business models is systematicity. It is necessary to study the transformation of digital business models from a systematic and holistic perspective in order to ensure the sustainable development of digital business models. Keiningham Propose a customer experience-oriented business model innovation framework that helps to enhance the value of products or services and/or deliver those products to customers to align customer value with the company's strategic needs[7].

The most important aspects of digital business model transformation are systematicity and complexity. The text attempts to use system dynamics to simulate the model of ig data capabilities on the innovation mechanism of new retail business models, and explore the impact mechanism of big data driving commercial innovation of new retail enterprises.

2 Influencing factors of big data on business model innovation

2.1 Concept of Big Data Capability

Research on the Concept of Big Data Capability divides data-driven innovation in new retail business models into data resource acquisition capabilities. Big data resource acquisition capabilities refer to the ability of enterprises to utilize big data capabilities to acquire a large number of internal or external data resources, data talents, or skills, and update them in a timely manner[6]. The data analysis and integration ability can analyze and organize complex data, obtain favorable data resources for enterprise business development, flexibly respond to market demand, and promote business model innovation. The application of big data application capabilities in user profiling and recommendation algorithms can accurately locate customers, explore deeper consumer needs, perceive consumer trends, and adjust enterprises based on trends to promote key business and process innovation in business models, driving the transformation and innovation of existing business models. Mining the hidden value behind data through data application capabilities provides support for enterprise decision-making.

2.2 Big data drives business model innovation

Innovation of New Retail Business Model Innovation of New Retail Business Model is a comprehensive strategy that integrates the power of the retail field, the power of digital technology, and excellent management capabilities. It positions the enterprise as the core, regards content as the highest, and regards innovative business models as the foundation, forming an organic whole. This innovation strives to achieve cross-border integration, not only integrating retail industry with service industry, manufacturing industry, online and offline fields, but also encouraging stakeholders such as enterprises, governments, suppliers, and research and development institutions to collaborate together. Through the organic integration of digital technology, this new retail model aims to enhance the value of the entire industry. Its core is to rethink the key elements of the business model, namely people, goods, and market, in order to adapt to the trend of digital consumption[8]. Meanwhile, the data-driven new retail business model closed-loop is a key component of this innovative strategy. Driven by strong data, new retail enterprises are committed to achieving seamless integration online and offline, digitizing the entire value chain, thereby enhancing their ability to create, transmit, and capture value, forming a continuously strengthened and sustainable dynamic cycle[9]. Its essence is the

fundamental principles of value proposition, value creation, and value capture [10].Enterprises use digital technology to perceive customer needs and purchase intentions, enhance user perceived value, analyze and guide the production and personalized marketing strategies of new products, optimize enterprise operations, and bring huge benefits to the enterprise.

3 Methodology

3.1. Theoretical framework model:

Big data has a complex path in the innovation of new retail business models, exhibiting characteristics of high order, multi feedback, and dynamism. Traditional methods, such as questionnaire surveys and empirical research on second-hand data, mainly rely on existing actual data and cases, aiming to reveal statistical patterns. However, these methods have certain shortcomings in simulating and predicting nonlinear dynamic feedback systems. System dynamics, as a discipline that studies information feedback and dynamic behavior of systems, places special emphasis on holism and the nonlinear characteristics of complex systems. Therefore, when exploring the dynamic relationship between big data and business model innovation, system dynamics has significant advantages[11]. The concept and ideas of big data new retail business model innovation remain in textual description. This article will implement the theory of system dynamics in the implementation of data-driven new retail business model innovation in new retail enterprises, and use Vensim software to carry out data-driven new retail business model innovation

3.2. System Boundary and Basic Assumptions

The foundation of system dynamics simulation analysis is to reasonably define the system boundary. In order to simplify the complexity of the model and focus on the key logic of the model in order to construct computational expressions, this article proposes the following assumptions: 1) The organizational penetration of innovation in the new retail business model driven by big data into enterprises is divided into data application ability, data integration ability, and data acquisition resource ability. 2) This model is based on the perspective of big data driving new retail enterprises, without considering the impact of other driving forces for the time being, 3) The impact of government and other emergencies on the system will not be considered for the time being[12].

3.3. Causal relationship diagram and main feedback paths

New retail enterprise investment → Data research and development expenses → Data resource acquisition ability → Data analysis and integration ability → Data application ability → Customer sales revenue → New retail enterprise income → New retail enterprise investment

Data resource acquisition ability → Number of data contacts → Revenue from data contacts → New retail enterprise income →New retail enterprise income → Data resource acquisition ability

Data resource and integration ability → New retail industry resource integration ability → Redundant resources → Resource cost →New retail enterprise investment →New retail enterprise investment → Data resource and integration ability

Data application ability → Marketing strategy ability → Potential customer volume → Demand identification ability → Customer satisfaction → Customer loyalty → Customer size → Customer sales revenue → New retail annual revenue → New retail annual investment data application ability

Marketing strategy ability → Potential customer volume → Demand identification ability → Customer satisfaction → Customer loyalty → Customer scale → Competition ability of new retail enterprises → Financing ability of new retail enterprises →investment of new retail enterprises → Data application ability → Marketing strategy ability

Logistics transportation capacity → customer satisfaction → customer loyalty → customer scale → customer sales revenue → annual revenue of new retail enterprises → annual investment of new retail enterprises → data application capacity → logistics transportation capacity

Innovation capability → Number of innovative products → Customer satisfaction → Customer loyalty → Customer scale → Customer sales revenue → revenue of new retail enterprises → investment of new retail enterprises → products development funds → Innovation capability

Data R&D expenses → Annual cost of new retail enterprises → Annual investment of new retail enterprises → Data analysis and integration capabilities → Data research and development expenses

The Figure 1 is the causal cycle diagram of this paper's big data-driven new retail business model innovation:

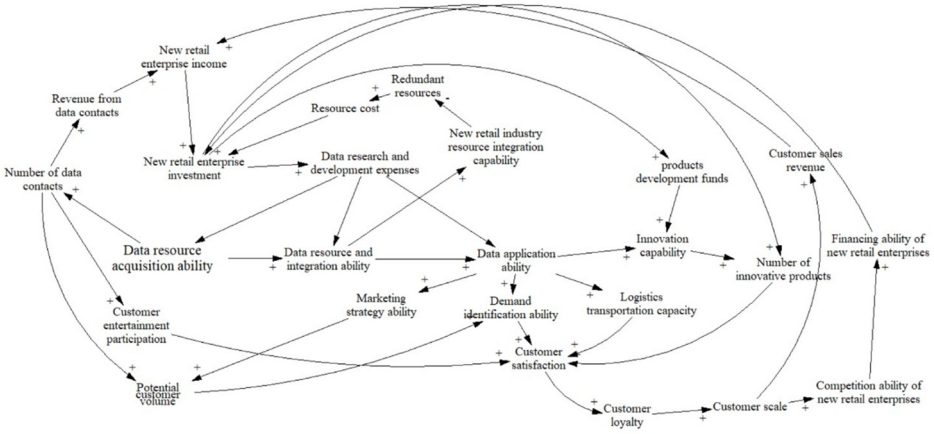

Figure 1 Data driven new retail business model innovation causal cycle

3.4 System Flow Diagram

System Flow Diagram System flow diagram is used to describe and analyze the behavior and interaction of dynamic systems, helping to visualize various causal relationships and feedback mechanisms within the system, in order to better understand the dynamic properties of the system. Based on system specific definitions, model assumptions, and causal loop diagrams, relevant variables are introduced. The overall system of the interaction between data resource acquisition ability, data application ability, data integration resource ability, and business model

innovation. The data resource acquisition ability enables new retail enterprises to obtain customer needs, improve customer profiles, increase the personalization of enterprise products, promote customer consumption and love, improve customer loyalty, and increase enterprise sales. The ability to integrate data resources, integrate upstream and downstream resources of new retail, allocate resources reasonably, reduce redundancy, and promote sales growth of enterprises. The ability to apply data can customize personalized marketing strategies, analyze and handle customer needs, improve logistics efficiency, and increase customer satisfaction and sales of enterprises while improving innovation capabilities. The Figure 2 is the flow chart of data-driven new retail business model innovation in this paper:

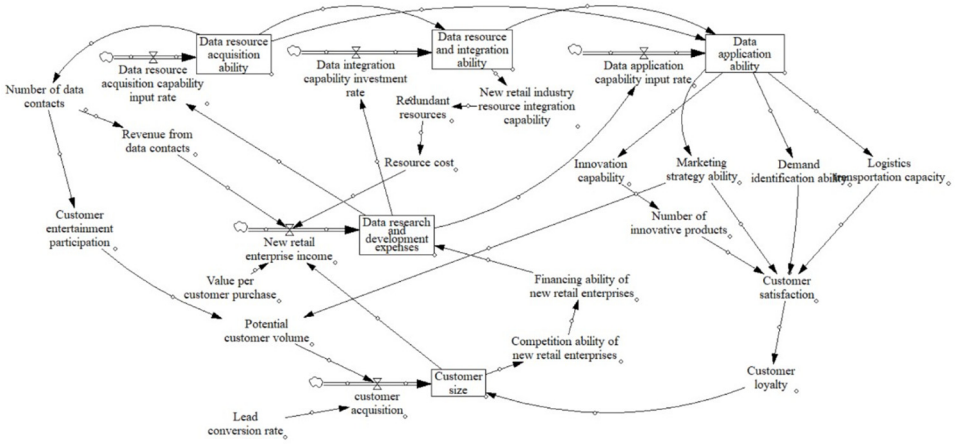

Figure 2 Flow chart of data-driven new retail business model innovation

4 Simulation of model

4.1 Case Simulation:

The simulation object is Xiaomi Home's new retail enterprise. In 2015, the Beijing store officially announced the expansion of its offline stores, shifting from a single online channel to a new retail business model that combines online and offline retail. The goal is to transform the inefficient retail industry with internet thinking, break information asymmetry, reduce costs, and provide consumers with a richer, personalized, and interactive shopping experience, Realize the integration of online and offline. Xiaomi Home collects customer calls through its data resource acquisition capabilities and associates them with devices. Based on Xiaomi's big data, it characterizes user characteristics and attributes, improves customer profiles, and uses user profiles to conduct future precision marketing and personalized services through data application capabilities[13]. Through data integration and resource capability analysis, products can make reasonable and efficient adjustments to regional inventory[14].

4.2 Main equations of the model

The main equations are explained a Table 1：

Table 1 Principal equation

New retail enterprise income	Revenue from data contacts+Value per customer purchase*Customer size-Resource cost
Data research and development expenses	Financing ability of new retail enterprises*0.1+New retail enterprise income*0.18
Data resource acquisition capability input rate	Data research and development expenses/100000
Data resource and integration ability	Data integration capability investment rate*Data resource acquisition ability
Data application ability	Data resource and integration ability*Data application capability input rate*Data resource acquisition ability
Customer size	INTEG(customer acquisition*Customer loyalty)
Customer satisfaction	(Number of innovative products^0.05+Logistics transportation capacity*0.25+Marketing strategy ability^0.25+Demand identification ability^0.25)/10
Potential customer volume	Marketing strategy ability*100+Customer entertainment participation*100
Data resource acquisition ability	INTEG (Data resource acquisition capability input rate,0.1)
Data resource and integration ability	INTEG (Data integration capability investment rate*Data resource acquisition ability,0.1)
Data application ability	INTEG (Data resource and integration ability*Data application capability input rate*Data resource acquisition ability,0.1)
Data resource acquisition capability input rate	INTEG(Data research and development expenses/100000)
Data integration capability investment rate	INTEG (Data research and development expenses*0.1/100000)
Data application capability input rate	INTEG（Data research and development expenses*0.15/10000）

4.3 model checking

Model Verification In this article, we adopt a method called extreme testing to verify the rationality, stability, and effectiveness of the model. When confirming the causal relationship and establishing the model, we not only referred to existing research results, but also revised and improved the model based on the actual situation. Through computer simulation, the results show that each equation has practical significance in the model, and the construction of the causal relationship model and feedback loop is quite reasonable. This article takes the customer size and disposable funds as 0, the data analysis and integration ability as the initial value, and the data application ability as the initial value, The result is shown in the figure3

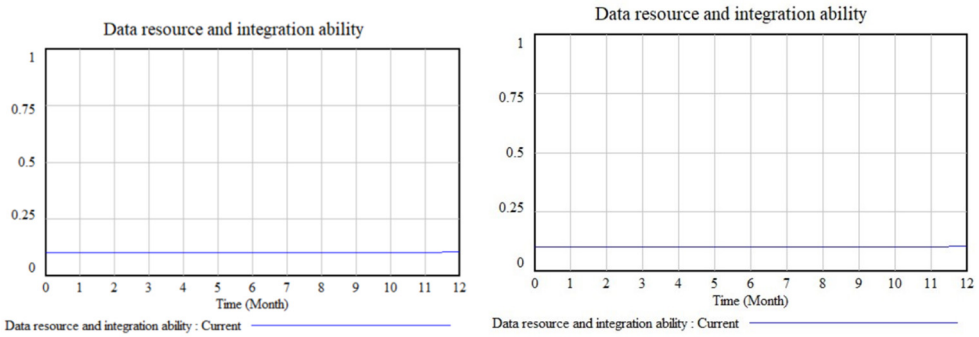

Figure 3 Extreme conditions test results

4.4 Control Variable Simulation Experiment:

An in-depth analysis of the ways and effects of big data on the revenue and customer size of new retail enterprises. Based on the initial simulation results, this article conducts a multi factor control variable simulation experiment, with a focus on the direct impact of data resource acquisition ability, data integration ability, data application ability, data touch points, redundant resources, innovative products, marketing strategy ability, recognition and push ability The transmission of intermediate factors such as logistics transportation capacity affects customer scale and enterprise revenue

(1)The impact of data collection ability remains unchanged for other abilities. By changing the data collection ability separately, simulation images are obtained, as shown in Figure 4, where current represents the baseline situation. Data collection ability directly affects the number of data contacts, data analysis and integration ability, and data application ability, through the transmission of intermediate factors such as customer entertainment participation, new customers, and enterprise income, The impact on data capability revenue and customer size, as data collection capabilities improve, corporate revenue evolves from linear growth to exponential growth.

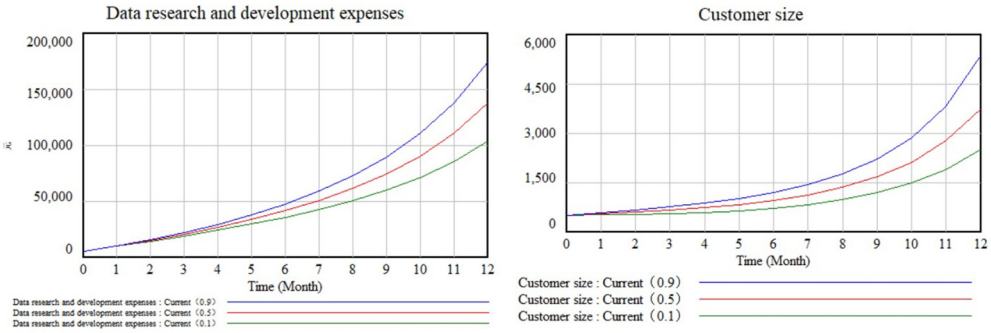

Figure 4 Control variable big data collection capability simulation results

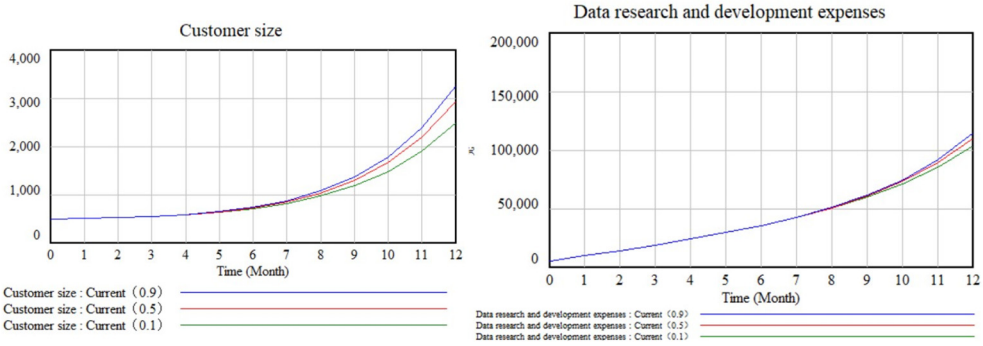

Figure 5 Control variable big data resource integration capability simulation results

(2) The impact of data collection capability remains unchanged for other capabilities. By changing the data resource integration capability separately, simulation images are obtained, as shown in Figure 5, where current represents the baseline situation. The data resource integration capability directly affects the resource integration capability and data application capability of new retail enterprises, affecting data capability revenue and customer size. As the data collection capability improves, Corporate income continues to grow relatively slowly. Customer scale has shifted from linear growth to exponential growth

(3) The impact of data collection capability remains unchanged for other capabilities, and the data The application capabilities are changed separately to obtain simulation images, as shown in Figure 6, where current represents the baseline situation. Data collection capabilities directly affect innovation capabilities, marketing capabilities, recognition and push capabilities, logistics service quality capabilities, and the transmission of intermediate factors such as customer loyalty, affecting data capability revenue and customer size. As data application capabilities improve, enterprise revenue continues to grow relatively slowly. Customer scale has shifted from linear growth to exponential growth

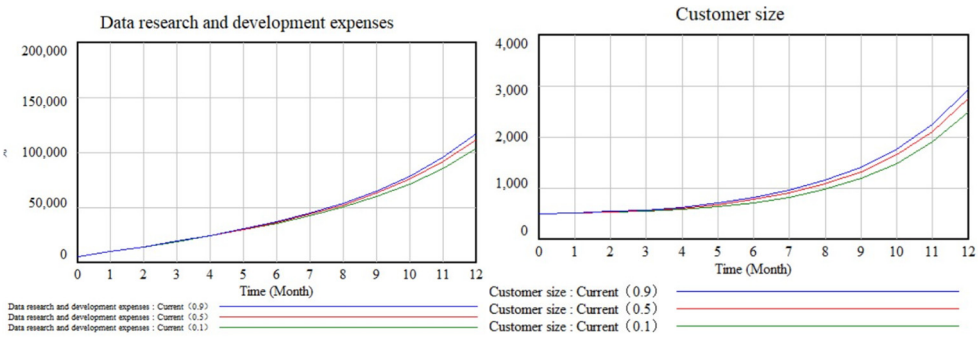

Figure 6 Control variable big data application capability simulation results

5.Conclusion

Based on a data-driven perspective, this article starts from the big data-driven innovation system of new retail enterprises, analyzes the marketing of data capabilities on the revenue and

customer size of new retail enterprises, and forms a data-driven model for new retail enterprise innovation. By using system dynamics modeling and simulation methods, the key factors affecting the revenue and customer size of new retail enterprises are analyzed in depth, The following conclusions are drawn: (1) The new retail business model driven by big data promotes customer scale and enterprise revenue from three aspects: data collection ability, data resource integration ability, and data application ability. Among them, data collection ability is the foundation of data integration ability and data application ability. (2) The process of data-driven new retail enterprises is a systematic engineering process, in which data capabilities affect the scale of bad customers in the enterprise's revenue. The causal loop diagram analyzes the driving path of data-driven innovation in new retail enterprises from a static perspective. The system dynamics model simulates the operation process of new retail enterprises driven by data capabilities from a dynamic perspective, further discovering the interaction relationship between customers, data, and enterprises, with customers as the main body, Big data capabilities drive optimal cost control and revenue enhancement for enterprises, enabling them to achieve maximum competitiveness.

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