The Impact of Big Data Capability on Enterprise Performance–theMediating Effect of Supply Chain Flexibility

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Abstract:Based on 234 survey data of 35 pilot demonstration enterprises in intelligent manufacturing, this paper tested the mediating role of supply chain flexibility in the process of big data capability affecting enterprise performance. The empirical results show that the foundation capability, application capability, and development capability all have a significant positive impact on enterprises performance. Big data foundation capability has a significant positive effect on the supply chain flexibility in terms of product flexibility, logistics flexibility and production flexibility, and it has no significant effect on purchasing flexibility and information flexibility. Both big data application capability and big data development capability have a positive effect on supply chain flexibility. In addition to purchasing flexibility, the other dimensions of supply chain flexibility and supply chain flexibility comprehensive factors all have a mediating effect on the relationship between big data capabilities and firm performance. The conclusions of this study have a positive enlightenment role for enterprises to develop big data capabilities and create a flexible supply chain to meet the needs of the market and customers.

Keywords:big data capability, supply chain flexibility, enterprises performance, mediating effects

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The commercial value of pull production and flexible supply chains has been apparent since Toyota's production methods, but only a very small number of companies have the resources and ability to adopt such models in the past 30 years. As the Internet, the Internet of things, big data, cloud computing, such as the rapid development of technolog y, the connection between the enterprise and the consumer become more close and convenient, enterprises can be economic, rapid, accurate and comprehensive collection of data and information related to consumer, and then according to the market demand changes in product design, raw materials procurement, manufacturing production, transportation and distribution, all aspects of the

supply chain closer together and flexible management, reduce the bullwhip effect of supply chain, make the response efficiency, action logic and thinking on gradually adapt to the rapid change of the market. Big data capability has become the key for enterprises to form sustainable competitiveadvantages. Therefore, it is an urgent problem to explore how to apply big data capability to enhance supply chain flexibility and improve enterprise performance.

From the theoretical perspective, a large number of studies have been conducted on the impact of big data capability on enterprise performance, and scholars generally agree that "big data capability will have a profound impact on enterprise competitive advantage". Hassna et al.(2018)[1] believe that the ability of big data can provide insight into user behaviors and preferences, monitor and optimize user experience, improve market response, and improve customer satisfaction. Mneney et al.(2016)[2] proposed that big data capability could promote the connection and optimization of the whole process of operation and management, enhance organizational flexibility and agility, promote network collaboration, improve the level of enterprise's internet-ization, and improve enterprise performance. Jose et al. (2016)[3] proved from the perspective of optimal price and profit maximization, Wang et al.(2015)[4] from the perspective of sales, market share, Gupta et al.(2016)[5] from the perspective of return on investment that big data can help enterprises reduce costs or improve the quality of products and services, thus improving enterprise performance. However, many scholars questioned the direct impact of big data capability on enterprise performance, believing that the impact of performance was mediated by other capabilities. For example, Lamba and Singh(2017)[6] pointed out that big data capability has an impact on enterprise performance through its complementary relationship with other companies' assets and capabilities. Minghui Cheng (2015)[7], Wamba S F et al.(2017)[8] respectively believed that decision rationality and process flexibility were important intermediary variables that helped establish the influence of big data capability on enterprise performance. SumeiZhong (2017)[9] believes that big data ability usually influences company performance through organizational learning ability. Previous studies have revealed the value creation process of big data capability from multiple levels, but most of them are only logical reasoning, and a few empirical studies have inconsistent conclusions. The mechanism of big data capability on enterprise performance from the perspective of supply chain flexibility needs to be further deepened.

In view of this, this study based on the dynamic capability theory and the theory of supply chain flexibility, follow the "large data capacity-supply chain flexibility-corporate performance" paradigm, based on supply chain flexibility mediation role of large data capacity performance mechanism empirical research model, are discussed theoretically large data capacity directly impact on the business performance, analyze the mediation effect of flexible supply chain.

THEORETICAL BASIS AND RESEARCH HYPOTHESIS

Theoretical Basis

Dynamic Capability Theory

Dynamic capability theory is an important perspective of strategic management research, which well explains the formation of sustainable competitive advantage of enterprises under dynamic environment, and effectively makes up for the deficiency of traditional industrial organization theory, resource-based theory and core competence theory in the combination of external environment and internal resources and capabilities. Teece et al.(1994)[10] put forward the concept of dynamic competence in 1994 and the framework of dynamic competence in 1997. They believed that dynamic competence is the ability of an enterprise to Integrate, Build and Reconfigure its internal and external competence to adapt to the rapid change of the external environment. They believe that "dynamic" emphasizes the speed and frequency of keeping pace with the rapidly changing external environment, while "capability" emphasizes the integration, optimization and adaptation of internal and external technologies, resources and functions to cope with changes in the external environment, so as to improve enterprise performance. Then Eisenhardt and Martin(2000)[11] defined dynamic capability as a specific, operational and measurable strategy and organizational process from the perspective of process. Specifically, dynamic capability is the process that enterprises use resources to match, adapt to and even create market

changes. From the perspective of organizational learning, Zollo and Winter(2002)[12] proposed that dynamic capability is a kind of continuous and stable organizational learning behavior, through which enterprisescan systematically improve, integrate and even reconstruct their operational processes to improve enterprise performance. Dynamic capability theory holds that dynamic capability (that is, the enterprise's ability to adjust to the external environment) is derived from the enterprise's asset potential and original path dependence, and is the fundamental source of competitive advantage.

As a key strategic resource of an enterprise, big data cannot bring competitive advantage to the enterprise by itself. Only when big data is raised to the level of enterprise capability can the commercial value contained in it be fully utilized and the goal of bringing lasting competitive advantage to the enterprise be realized. Dynamic competency theory recommends the development of organizational systems, practices, and processes, emphasizing that organizational learning enables companies to respond to emerging environmental threats and opportunities. The purpose of building enterprise big data capability is to effectively apply and deploy relevant big data resources, technologies and knowledge to obtain competitive advantages according to the changing environment. From this perspective, enterprise big data capability is actually a dynamic capability. We define it as the big data infrastructure based business calls, deployment, and effective use of big data and related organizational resources, enhance functional departments operating flexibility and efficiency, promote decision-making system integration and reconstruction of continuous learning innovation to predict, to adapt to changes in the external environment, and enhance the competitive advantage and performance of the enterprise knowledge, technology, experience and skills. In recent years, the research focus of scholars has shifted from whether big data capability improves enterprise performance to how big data capability influences and how enterprises should build and apply big data capability to improve enterprise performance.

Flexible Supply Chain Theory

Research on supply chain flexibility is a subject with important theoretical and practical value at home and abroad. Supply chain flexibility is an important strategy for enterprises to cope with market changes. Das and Patel (2002)[13] pointed out that flexibility represents the supply chain's ability to respond to uncertainty. The greater flexibility, the stronger the supply chain's ability to adapt to changes in market demand. Sawhney (2006)[14] found that flexibility can be transferred between upstream and downstream enterprises of the supply chain. Supply chains that actively adopt flexible strategies can create more opportunities to gain competitive advantages. Gupta and Somers (2009)[15] believed that enterprise strategy would affect the level of supply chain flexibility, and organizations lacking the ability to predict future market changes would need a higher level of supply chain flexibility.

Rapidly leap in the current technology, product innovation cycle shorten constantly, increasing customer demand changes of environment, enterprise business model, value creation and strategic control means changing, user-driven, networked manufacturing, real-time insight become the key to obtain the sustainable competitive advantage[16], all of which to the enterprise supply chain flexibility, economy and rapid implementation of the balance of supply and demand higher requirements are put forward. The delayed transmission of demand signal will lead to the mismatch between procurement and supply plan, which cannot meet the market demand. It will not only cause a large amount of overstock of unsaleable products, but also lead to the phenomenon of insufficient supply of best-selling products, which will lead to the rising cost and eat up the profits of enterprises. At the same time, as the supply chain becomes more and more complex, more accurate methods and tools must be adopted to improve the ability of the supply chain system to respond quickly to the needs of users. For these problems, the enterprise can make full use of big data technology, further understand the consumer behavior and demand, and with the establishment of closely linked, precision marketing, at any time according to the consumer purchase intention production, balance of purchasing, demand and inventory, eliminate inventory shortage or surplus, thus promote supply chain flexibility and become the core competitiveness of the enterprise development[17].

Research Hypothesis

Big Data Capability and Enterprise Performance

A large number of literatures have pointed out that big data capability has a positive impact on enterprise performance. Hassna et al.(2018)[1] believe that big data can provide insight into user behavior and preference, monitor and optimize user experience, improve market response and customer satisfaction. Wang tianhe(2015)[18] found in his research that by integrating internal and external big data resources, enterprises can predict and adapt to changes in the external environment and reduce operational decision-making risks through in-depth analysis. XieWeihong(2016)[19] pointed out that high level of big data capability helps enterprises to timely obtain data and information from the whole process of product life cycle and each link of enterprise value chain, and provides support for decision makers to make decisions quickly and accurately. Mneney et al.(2016)[2] proposed that big data capability could promote the connection and optimization of the whole process of operation and management, enhance organizational flexibility and agility, promote network collaboration, improve the level of enterprise's internet-ization, and improve enterprise performance. In addition, scholars have empirically tested that big data can help enterprises reduce costs or improve the quality of products and services, so as to improve the performance of enterprises in terms of price optimization and profit maximization[3], sales volume and market share[4], return on investment[5] and other aspects. Therefore, the following hypothesis is proposed:

H1: Big data capability has a significant positive impact on enterprise performance.

Big Data Capability and Supply Chain Flexibility

Supply chain flexibility is essentially the ability of enterprises to cope with environmental uncertainty economically and quickly through supply chain management and coordination with supply chain members[20]. Cheng Minghui(2015)[7] found that changing external circumstances, the enterprise through the use of big data can improve the ability of facing the external environment change, specifically the enterprise can timely detect the changes in market demand, so as to adjust the safety stock level, maximum inventory, purchasing lead time, purchase volume, etc., establishing optimization of stock structure and inventory levels, enhance flexible products and purchasing. Through large data capacity is more optimized transport management, road capacity on resources management and the construction of overall process of visualization, transfers of goods between the optimization of the distribution center as well as reasonable selection and management outsourcing carriers, as well as their own team, so as to improve enterprise's ability to in charge of business risk, optimize enterprise operation and service quality. Big data capability provides important support for information acquisition and dissemination and real-time prediction and analysis of consumer demand changes, and helps enterprises at supply chain nodes to timely meet customer needs[21]. Jing Hao(2014)[22] believes that by effectively processing big data, enterprises can obtain a large amount of information about enterprises' operational activities and realize effective sharing of information among members of the supply chain, so as to increase information transparency among enterprises. Liu Yili(2008)[23] believes that enterprises with big data collection, integration, analysis and mining capabilities can improve abundant information resources and increase knowledge stock for supply chain links. Knowledge stock and innovation capacity in supply chain directly determine supply chain flexibility. Cheng Gang(2014)[24] believes that enterprises with good big data capabilities can, on the one hand, further understand the needs of customers through the collection, mining and analysis of customer data, and improve more personalized products and services to improve customer loyalty. On the other hand, through the analysis of customer demand, problems in enterprise products and services can be found, which provides an important basis for enterprise product upgrading. To sum up, with the development of Internet, Internet of things, big data and cloud computing, production enterprises and consumers are closely connected, and the data and information required by consumers can be quickly transmitted to enterprises. According to the change of market demand, the enterprise product design, raw materials procurement, manufacturing production, transportation, distribution, supply chain closer together and flexible management, reduce the bullwhip effect of supply chain, make the response efficiency, action logic, and gradually adapt to the market rapidly changing ways of thinking, to achieve a more "flexible" management. Big data capabilities help enterprises upgrade existing products, develop new products, improve

information communication between enterprises, and timely meet customer needs. Therefore, the following hypothesis is proposed:

H2: Big data capability has a significant positive impact on supply chain flexibility.

Mediating Effects of Supply Chain Flexibility

On the one hand, the enterprise can pass to each node enterprise supply chain between data information and customer demand information fetching and mining, deep insight into the customer demand, reduce the information asymmetry between enterprises, improve the flexible information system, and can be based on the in-depth analysis of the data timely response to market conditions and customer demand change, better adapt to environmental changes, thus its supply chain flexibility. On the other hand, supply chain flexibility responds to changes in the market environment timely from five dimensions: product flexibility, procurement flexibility, logistics flexibility, production flexibility and information flexibility, so as to meet customer needs, improve customer satisfaction, achieve sales growth and promote the improvement of enterprise performance. Therefore, this paper proposes that the impact of big data capability on enterprise performance can be transmitted through the implementation of supply chain flexibility strategy, and the "black box" of the impact of big data capability on enterprise performance can be uncovered, that is, supply chain flexibility plays an intermediary role in the relationship between big data capability and enterprise performance. Therefore, the following hypothesis is proposed:

H3: In the influence of big data capability on enterprise performance, supply chain flexibility plays an intermediary role.

The research framework of this paper is shown in figure 1.

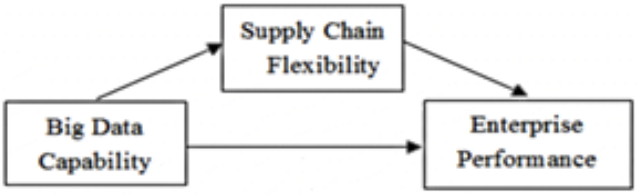

Figure 1 Research Framework

RESEARCH METHODS

The Sample

This study took 2015, 2016, 2017 and 2018 intelligent manufacturing pilot demonstration enterprises released by the Ministry of Industry and Information Technology as survey samples, involving 208 enterprises and 27 regions. It contacted the target enterprises through email and distributed online questionnaires. In October 2018 - March 2019, the author through the above

two ways out 587 questionnaires, recycling questionnaire 278, excluding not good incomplete implementation of big data applications, questionnaire, continuous check the same score options, such as invalid questionnaire, eventually get effective questionnaire 234, the total recovery of 47. 4%, effective questionnaire recovery was 39. 9%. The main statistical characteristics of the samples are shown in table 1.

Table 1
Main Statistical Characteristics of the Samples

Enterprise Characteristics	Classification	Frequency	Percentage	Enterprise Characteristics	Classification	Frequency	Percentage
Date of Establishment	1-5 years	20	8.5%	Enterprise Size (number of employees)	300 and below	30	12.8%
	6-10 years	50	21.3%		301-1000	32	13.6%
	11-15 years	44	18.8%		1001-2000	30	12.8%
	16-20 years	56	23.9%		2001-3000	62	26.4%
	More than 20 years	64	27.3%		More than 3000	80	33.8%
Annual Sales (yuan)	Below 30 million	26	11.1%	Nature of Ownership	State-owned enterprise	70	29.9%
					Collective enterprise	18	7.7%
	30 million - 100 million.	28	11.9%		Private enterprise	116	49.6%
	101 million - 200 million.	32	13.6%		Hong Kong, Macao and Taiwan owned and holding companies	0	0%
	201 million - 300 million.	38	16.2%		Wholly foreign-owned and holding enterprises	30	12.8%
	More than 300 million	110	47.0%		other	0	0%

Variable Measurement

Independent Variable: Big Data Capability

In this paper, according to the idea ofCapability hierarchy differentiation perspective[25]and the dynamic Capability hierarchy model construction[26], Big Data Capability is divided into three dimensions: Big Data Foundation Capability, Big Data Application Capability and Big Data Development Capability. Big data foundation ability is the ability to build big data technology and infrastructure platform to provide reliable big data services for enterprises. Enterprises use big data technology to plan, build and operate big data platform for the purpose of promoting the real-time integration and sharing of data and resources within and between enterprises, promoting the efficient operation and scientific decision-making of enterprises, so as to achieve better economies of scale and economies of scope. Big Data Application Capability is the enterprise's ability to effectively organize and utilize big data and other complementary resources, fully embed big data into the enterprise's operation and management decision-making process, and realize the efficient integration of business units, supply chain system and value network. Big data development capability refers to the ability of enterprises to make use of big data resources, continuously integrate and reconstruct enterprise systems, processes and conventions, so that enterprises can better adapt to the environment, constantly break their own inherent conventions and patterns, and realize continuous innovation.According to Jiang Chunyu[27], Meng Xiangfei[28], Huang Mingfeng[29], this paper draw big data capability into three dimensions,namely big data foundation capacity, big data application ability and big data development capacity, respectively, with five, eight, seven measuring item, a total of 20 questions.

Intermediary Variable: Supply Chain Flexibility

In this study, supply chain flexibility refers to the ability to produce consumer demand-oriented products economically and quickly through effective supply chain management and coordination with supply chain members. Based on previous studies, Fantazy et al.(2009)[30] divided supply chain flexibility into new product flexibility, procurement flexibility, delivery flexibility and information system flexibility. Qi Yibing(2010)[31] divided supply chain flexibility into operation flexibility, logistics flexibility, information flexibility, robust network and re-reconstruction flexibility. This paper divides supply chain flexibility into five dimensions, namely product flexibility, procurement flexibility, logistics flexibility, production flexibility and information system flexibility, with 21 questions.

Dependent Variable: Enterprise Performance

Enterprise performance is the degree to which an enterprise achieves a specific goal. It is a multi-dimensional complex construct. Previous studies usually use two indicators to evaluate the level of enterprise performance: one is financial indicators, such as return on investment, return on assets, return on sales, profit growth rate and sales revenue growth rate. The other is non-financial target indicators, such as market response speed, internal operational efficiency, customer evaluation, and innovation speed[32]. With reference to Tippins and Sohi(2003)[33] and Wang et al.(2015)[34], this study measures enterprise performance from the aspects of finance and market, with a total of 9 questions.

Control Variables

In order to control the influence of other variables on enterprise performance, this study takes three indicators such as enterprise age, enterprise size and enterprise ownership nature as control variables. First, the age of a business is measured by the age of its founding. Generally, the longer an enterprise is established, the lower its willingness to implement big data strategic change and enterprise performance will be, and the mediating effect of supply chain flexibility may be weakened. Secondly, the scale of the enterprise is measured by the number of employees. The scale of employees is divided into five categories: less than 300 employees, 301-1000 employees, 1001-2000 employees, 2001-3000 employees and over 3000 employees, which are assigned with the values of 1, 2, 3, 4 and 5, respectively. Generally, the larger the enterprise scale is, the higher the rigidity degree of operation and decision-making is when the enterprise implements big data strategy, and thus the influence effect of big data capability will be reduced. Finally, the property of enterprise ownership is measured by dummy variables, including four types of state-owned enterprises, collective enterprises, private enterprises and

foreign-funded enterprises. Due to the relatively large number of private enterprises, this type of enterprise is selected as a reference variable, and the other three types of enterprises are assigned dummy variables.

Reliability and Validity Analysis

In this paper, the consistency coefficients of big data capability, supply chain flexibility and enterprise performance are 0.924, 0.882 and 0.910, respectively. Cronbach's alpha coefficient of each variable is above 0.7, and the total expression is 0.912. It can be seen that the subscales and total scales of big data capability, supply chain flexibility and enterprise performance have good reliability, and the scale has good reliability. The detailed data are shown in table 2.

Table 2
Cronbach's Alpha Coefficients of Each Variable

Variable		Cronbach's alpha coefficient	
Big Data Capability (20items)	Big data foundation ability (5 items)	0.924	0.826
	Big data application capability (8 items)		0.842
	Big data development capability (7 items)		0.851
Supply Chain Flexibility (21items)	Product flexibility (4 items)	0.882	0.883
	Procurement flexibility (4 items)		0.903
	Logistics flexibility (4 items)		0.891
	Production flexibility (4 items)		0.875
	Information flexibility (5 items)		0.885
Enterprise Performance (9 items)	Short-term financial performance (5 items)	0.910	0.884
	Long-term competitive advantage (4 items)		0.852

In this article, through exploratory factor analysis and confirmatory factor analysis to test measurement tool of content validity and construct validity of large data capacity, flexible supply chain and enterprise performance carries on the exploratory factor analysis, through the table 3 shows that the value of KMO, respectively 0.759 and 0.858 and 0.881, Baetlettsphericity test significant probability is 0. 000 (* * *), showed that good effect, can be the next step of factor analysis.

Table 3
KMO and Bartlett SphericityTests

KMO and Bartlett SphericityTest		Big Data Capability	Supply Chain Flexibility	Enterprise Performance
Kaiser-Meyer-Olkin Measure ofSampling Adequacy		0.759	0.858	0.881
Bartlett's Test ofSphericity	Approximate chi-square distribution	584.296	772.275	310.416
	Degrees of freedom	120	231	36
	Significance probability	0.000	0.000	0.000

In order to ensure the validity of the measurement tool, AMOS 24.0 statistical software was used in this paper to conduct confirmatory factor analysis on the data. The fitness test of the model was mainly carried out by measuring the model to verify the convergent validity of each variable. Bagozzi and Yi[35] believe that the ideal range of fitness indicators is that both GFI and CFI are greater than 0.9, or greater than 0.8 is acceptable, and RMR and RMSEA should be less than 0.08. The results of each index of confirmatory factor analysis in this

study are shown in table 4, which indicates that the model validation index of the questionnaire is acceptable, indicating that the questionnaire has a good structural validity.

Table 4
Results of Confirmatory Factor Analysis

Fitting Index	χ^2/df	GFI	CFI	TLI	RMR	RMSEA	NFI
Big DataCapability	2.323	0.879	0.903	0.954	0.065	0.026	0.909
Supply Chain Flexibility	2.530	0.813	0.660	0.805	0.074	0.043	0.903
Enterprise Performance	1.785	0.831	0.938	0.914	0.036	0.074	0.873

DATA ANALYSIS AND RESULTS

Descriptive Statistics and Correlation Coefficient Matrix Analysis

The mean, standard deviation and correlation coefficient of each scale are statistically analyzed in this paper, and the specific results are shown in table 5. As can be seen from the table, there is a relatively significant correlation between the variables.

Table 5
Descriptive Statistical Analysis and Correlation Coefficients between Variables

Variate	1	2	3	4	5	6	7	8	9	10
1. Big Bata foundation Ability	1									
2.Big Data ApplicationAbility	0.89**	1								
3.Big Data Development Capability	0.65**	0.69**	1							
4.Flexible Product	0.44**	0.54**	0.66**	1						
5.Procurement of Flexible	0.64**	0.63**	0.69**	0.76**	1					
6.Logistics Flexible	0.52**	0.59*	0.80**	0.82***	0.80**	1				
7.The Production of Flexible	0.56**	0.63**	0.78**	0.73**	0.75*	0.87**	1			
8.FlexibleInformation	0.61**	0.62**	0.75**	0.60*	0.75**	0.70**	0.68**	1		
9.Financial Performance	0.72**	0.70**	0.70**	0.67**	0.74**	0.74**	0.64**	0.62**	1	
10.Market Performance	0.51**	0.50***	0.67**	0.66**	0.68**	0.80**	0.71*	0.51**	0.78**	1
The Average	3.68	3.45	3.72	3.59	3.68	3.71	3.68	3.53	3.82	3.86
The Standard Deviation	0.76	0.83	0.84	0.79	0.67	0.75	0.83	0.78	0.61	0.73

Note: (1) * p<0.1, ** p<0.05, *** p<0.01(two-tailed test) (2) N=234

Regression Analysis of the Relationship between Big Data Capability and Enterprise Performance

Table 6 shows the specific regression analysis results of the relationship between big data capability and enterprise performance. It can be seen from model 1 and model 6 that for the three control variables, enterprise age, enterprise size and enterprise nature have no significant impact on enterprise performance (financial performance and market performance). According to the regression analysis results of the main effects of model 2-4 and model 7-9, all three dimensions of big data capability have a significant positive impact on corporate financial performance and market performance (beta = 0.176, P<0.05). Beta = 0.250, P<0.05, Beta = 0.219, P<0.01, Beta = 0.309, P<0.01, Beta = 0.110, P<0.01, Beta = 0.231, P<0.01,), R2, R2 increased significantly after adjustment, and F value was significant at the level of 5%. However, the analysis results of model 5 and model 10 show that when big data application ability and big data development ability are

included at the same time, the foundation ability of big data becomes insignificant, and R2, R2 and R2 increase significantly after adjustment, and F value is significant at the level of 1%. The above results show that except that the big data foundation ability has a significant positive effect on enterprise performance((financial performance, market performance)), the application ability of big data and the development ability of big data have a significant positive effect on enterprise performance (financial performance, market performance), and the overall effect of the regression model is relatively ideal.

Table 6
Regression Analysis Results of Relationship between Big Data Capability and Enterprise Performance

Variate	Financial Performance					Market Performance				
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Constant Term	13.215	14.126	15.768	14.875	13.832	15.239	14.776	13.987	13.854	14.212
Enterprise Age	-0.158	-0.143	-0.156	-0.152	0.140	-0.215	-0.276	-0.078	-0.109	0.075
The Enterprise Scale	0.247	0.282	0.271	0.216	0.201	0.321	0.298	0.337	0.306	0.348
Enterprise Nature	-0.321	-0.415	-0.342	-0.328	-0.317	-0.379	-0.401	-0.118	-0.216	-0.195
Big Data foundation Ability		0.176**			0.225		0.250**			0.219
Big data Application Ability			0.219***		0.241***			0.309***		0.241***
Big data Development Capability				0.110***	0.123***				0.231***	0.123***
R^2	0.420	0.418	0.426	0.414	0.437	0.287	0.322	0.373	0.403	0.428
Adjusted R^2	0.378	0.395	0.411	0.403	0.421	0.253	0.247	0.365	0.400	0.411
ΔR^2	-	0.012	0.018	0.015	0.035	-	0.020	0.024	0.022	0.027
The F value	16.426***	7.352***	9.215**	7.676***	8.913***	9.554**	4.657***	7.132**	6.529***	3.223***

Note:(1) * p<0.1, ** p<0.05, *** p<0.01(two-tailed test) (2) N=234

Regression Analysis of the Relationship between Big Data Capability and Supply Chain Flexibility

Table 7 shows the regression analysis results of the relationship between big data capability (foundation capability, application capability and development capability) and supply chain flexibility (product flexibility, procurement flexibility, logistics flexibility, production flexibility and information flexibility). As can be seen from model 1, model 3, model 5, model 7 and model 9, for the three control variables, enterprise size has a negative impact on the five dimensions of supply chain flexibility, and enterprise age and enterprise nature have no significant impact on supply chain flexibility. In the influence path of big data capability on supply chain flexibility, the foundation capability of big data has a significant positive impact on product flexibility, logistics flexibility and production flexibility (beta = 0.155, P<0.01). Beta = 0.187, P<0.01, Beta = 0.223, P<0.01), However, the fundamental ability of big data has no significant impact on procurement flexibility and information flexibility (beta = 0.212, P>0.1, Beta = 0.305, P>0.1), Finally, big data application ability and big data development ability have significant positive effects on product flexibility, procurement flexibility, logistics flexibility, production flexibility and information flexibility (beta = 0.205, P<0.01, Beta = 0.267, P<0.01, Beta = 0.238, P<0.01, Beta = 0.321, P<0.01, Beta = 0.241, P<0.01, Beta = 0.133, P<0.01, Beta = 0.149, P<0.01, Beta = 0.201, P<0.01, Beta = 0.392, P<0.01, Beta = 0.125, P<0.01).).

Table 7
Regression Analysis Results of Relationship between Big Data Capability and Supply Chain Flexibility

Variate	Flexible Product		Procurement of Flexible		Logistics Flexible		The Production of Flexible		Flexible Information	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Constant Term	15.798	16.215	16.432	17.418	15.489	15.377	16.267	16.431	17.887	17.012
Enterprise Age	-0.112	-0.152	-0.137	-0.149	-0.128	-0.207	-0.232	-0.187	-0.149	-0.132
The Enterprise Scale	-0.215**	-0.279**	-0.267**	-0.286**	-0.281**	-0.305**	-0.301**	-0.345**	-0.229**	-0.313**
Enterprise Nature	0.314	-0.305	-0.422	-0.397	-0.375	-0.354	-0.424	-0.379	-0.339	-0.321
Big Data foundation Ability		0.155***		0.212		0.187**		0.223**		0.305
Big Data Application Ability		0.205***		0.267***		0.238***		0.321***		0.241***
Big Data Development Capability		0.133***		0.149***		0.201***		0.392***		0.125***
R^2	0.241	0.398	0.379	0.382	0.426	0.487	0.342	0.377	0.303	0.387
Adjusted R^2	0.212	0.387	0.302	0.375	0.417	0.464	0.298	0.356	0.300	0.365
ΔR^2	-	0.012	-	0.012	-	0.027	-	0.021	-	0.030
The F value	16.426***	7.352***	9.215**	7.676***	8.913***	9.554**	4.657***	7.132**	6.529***	3.223***

Note: (1) * p<0.1, ** p<0.05, *** p<0.01(two-tailed test) (2) N=234

Regression Analysis of Mediating Effect of Supply Chain Flexibility

Table 8 shows the analysis results of the mediating effect of supply chain flexibility on the relationship between big data capability and enterprise performance. In addition, on the basis of model 1 and model 2, five different dimensions of supply chain flexibility and overall supply chain flexibility are gradually added in this paper to reflect the intermediary effect of supply chain flexibility hierarchically. The analysis results from model 3-7 show that product flexibility (beta =0.226, P<0.01), procurement flexibility (beta =0.251, P<0.01), logistics flexibility (beta =0.176, P<0.01), production flexibility (beta =0.198, P<0.01) and information flexibility (beta =0.213, P<0.05) all produce significant positive mediating effects. However, in model 8, when product flexibility, procurement flexibility, logistics flexibility, production flexibility and information flexibility are included at the same time, the mediating effect of procurement flexibility (beta =0.132, P>0.1) becomes insignificant. Further, in 9, the model structure of the supply chain flexible composite factor (" supply chain flexibility "comprehensive factor score =" flexible "product factor score by the factor of variance contribution rate +" flexible "purchasing factor score by the factor of variance contribution rate +" logistics flexible factor score by the factor of variance contribution rate + "flexible" production factor score by the factor of variance contribution rate + information flexible factor score by the factor of variance contribution rate), according to the mediation of flexible supply chain effect significant at the 1% level (beta = 0.932, P < 0.01). Moreover, from model 1 and model 2 to model 3 and model 9, R2, adjusted R2, R2 and F all increased significantly, indicating that the effect of this model is relatively ideal.

Table 8
Regression Analysis of Intermediary Effect of Supply Chain Flexibility

Variate	Enterprise performance								
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Constant Term	13.078	14.214	13.876	13.743	14.358	14.562	15.073	15.176	14.387
Enterprise Age	-0.165	-0.159	-0.184	-0.173	0.163	-0.215	-0.236	-0.175	-0.143
The Enterprise Scale	-0.216**	-0.205**	-0.212**	-0.198**	-0.211**	-0.321**	-0.287**	-0.298**	-0.276**
Enterprise Nature	-0.298	-0.396	-0.303	-0.321	-0.309	-0.379	-0.381	-0.353	-0.305
Big Data Resource Base Capacity		0.152***	0.157***	0.173**	0.167	0.158*	0.163***	0.182***	0.032
Big Data Technology Application Ability		0.156***	0.089	0.042	0.096***	0.121***	0.103***	0.027***	0.056**
Application Ability of Big Data Management		0.163***	0.023**	0.051	0.102***	0.065***	0.077**	0.053***	0.125***
Flexible Product			0.226***					0.158**	
Procurement of Flexible				0.251***				0.132	
Logistics Flexible					0.176***			0.101***	
The Production of Flexible						0.198***		0.134***	
Flexible Information							0.213**	0.175***	
Supply Chain Flexible Synthesis Factor									0.932***
R^2	0.375	0.403	0.428	0.455	0.479	0.458	0.492	0.529	0.676
AdjustedR^2	0.286	0.387	0.401	0.421	0.433	0.424	0.447	0.501	0.589
ΔR^2	-	0.032	0.035	0.043	0.039	0.035	0.038	0.065	0.039
The F value	8.251***	5.374***	9.767**	10.638**	11.879***	9.812**	8.760***	8.897**	17.553***

Note: (1) * p<0.1, ** p<0.05, *** p<0.01(two-tailed test) (2) N=234

In conclusion, except procurement flexibility, supply chain flexibility of other dimensions and comprehensive factors of supply chain flexibility have a mediating effect on the relationship between big data capability and enterprise performance, indicating that hypothesis 3 has passed the empirical test on the whole. In addition, in order to verify the robustness of the flexible mediating effect of supply chain, Sobel test method and Bootstrap method were used in this study to conduct variable relationship analysis. The calculation formula of Sobel edge detection algorithm to check Z value is as follows: where, a represents the non-standardized coefficient of influence of independent variable (big data capability) on intermediary variable (supply chain flexibility), which is the corresponding standard error. B represents the non-standardized coefficient of the influence of the intermediary variable (supply chain flexibility) on the dependent variable (enterprise performance), which is the corresponding standard error. The specific intermediate effect test results of knowledge creation process are shown in table 9.

Table 9
Robustness Test of Flexible Inter-mediation Effect of Supply Chain)

Variate			Sobel Tests the Z Value	Bootstrap(95% confidence interval)	
The Dependent Variable	The Independent Variables			A Confidence Interval(P)a	A Confidence Interval(BC)b
Enterprise Performance	Big data capability		3.358***	(0.01025,0.04387)	(0.01137,0.04859)
	Dimensions	Big Data foundation Ability	3.213**	(0.03124,0.05098)	(0.03269,0.05431)
		Big Data Application Ability	3.576***	(0.03568,0.05676)	(0.03723,0.05997)
		Big Data Development Capability	3.389***	(0.03249,0.05175)	(0.03472,0.05563)

Note: [a] Pencentile confidence interval. [b] Bias-corrected confidence interval. * p<0.1, ** p<0.05, *** p<0.01

According to table 9, Sobel test results of big data foundation ability, big data application and

big data development ability are: Z = 3.213, P <0.05. Z = 3.576, P <0.01, Z = 3.389, P <0.01. Meanwhile, the Sobel test result of the overall big data capability is Z= 3.358, P<0.01. The above results show that supply chain flexibility has a mediating effect on the three dimensions of big data capability and on the relationship between big data capability and enterprise performance, and on the relationship between the overall structure of big data capability and enterprise performance. In addition, the confidence interval value obtained by Bootstrap method further verified the edge test result of Sobel, proving that the flexibility of supply chain plays a mediating role. The above results further verify hypothesis 3 empirically, that is, supply chain flexibility can have an intermediary effect on the relationship between big data capability and enterprise performance.

RESEARCH CONCLUSION AND DISCUSSION

Research Conclusion

We respectively tested the relationship between "big data foundation ability, big data application ability and big data development capacity" and enterprise performance. The main research hypothesis is supported.

(1)There are significant differences in the influence of big data capabilities on enterprise performance. When the enterprise has a high application and development ability of big data, the enterprise has a higher enterprise performance. However, the foundation ability of big data has no significant impact on the enterprise performance. This shows that although the foundation capability of big data is an important part of the capability of big data, it cannot significantly improve the performance of enterprises. This is consistent with the conclusion of the dynamic capability theory, that is, the static resource capability cannot help enterprises to shape long-term competitive advantages in the changeable environment.Under the background of big data era, the application and development ability of big data formed by combining enterprise big data resources and enterprise big data technology is the source of enterprise competitiveness, and big data capability is essentially a dynamic capability.

(2)The influence of each dimension of big data capability on supply chain flexibility is significantly different. The foundation ability of big data has a significant positive impact on product flexibility, logistics flexibility and production flexibility. Among the foundation resources of big data, data resource is the most foundation and core resource, which is the basis of the big data capability of enterprises. Different from the previous internal data of enterprises, in the era of big data, enterprises collect data from a wider range of sources, including unstructured and semi-structured data including mobile devices and social networks. Massive and diversified data provide a higher possibility for enterprises to understand the real needs of consumers. And big data infrastructure of no significant impact of procurement of flexible, flexible information, this is because the purchasing flexibility not only requires companies to have better understanding of consumer demand, at the same time also need to consider the supply chain upstream of the raw material information, it is not only poses a challenge to enterprise data and data sources, but also to the enterprise data integration and analysis ability put forward higher requirements. Therefore, a single resource-based capacity is insufficient to provide enterprises with higher procurement flexibility. In addition, the foundation ability of big data has no significant impact on the flexibility of supply chain information system, because the foundation resource ability of big data focuses on the collection and integration of enterprise foundation resources, while the application ability of big data technology emphasizes the update and application of data analysis technology. Independent ability of foundation resources, and big data applications to impact on information system, only by combining the two by the latest data analysis related technical data relevant to the supply chain upstream and downstream processing enterprises, can lead to higher for the enterprise information system flexible, big data application ability of information system of the flexible significantly positive influence also proved this conclusion. Finally, big data capacity, development of big data capacity was applied to production flexible, flexible, logistics procurement, flexible, flexible, and flexible information all have significant positive influence, this is because the big data application ability and big data capacity development as a higher-order ability, by optimizing the supply chain operation process and

improve the level of decision-making improve supply chain flexibility.

(3)Supply chain flexibility plays a part of intermediary role in the influence of big data capability on enterprise performance. Big data capability has a significant positive correlation with both corporate finance and market performance, but it has no impact on procurement flexibility, that is, procurement flexibility has no mediating effect on the relationship between big data capability and corporate performance. The possible reason for this result is that procurement flexibility is the enterprise's ability to better maintain the supplier relationship network in the changing environment, and to meet the variety and demand of customers in the market. Its role is reflected through production flexibility and product flexibility. Businesses use big data to bring the huge amounts of information and data ultimate aim is to produce the products meet the market demand, from this point of view, big data capacity through product information flexible, flexible, production logistics, flexible and flexible indirect impact on enterprise performance, namely product information flexible, flexible, production logistics, flexible and flexible in big data capacity plays a joint mediation effect on market performance, rather than by purchasing the flexible improve enterprise performance is reasonable.

Management Enlightenment

At present, most enterprises have started to realize the importance of big data in enterprise operation and management decision-making, and have made a lot of efforts in the construction of big data capacity of enterprises. However, many enterprises' big data practices are still based on "project investment, lack of overall planning", and have not formed a systematic "landing" path of big data. This study provides some management inspirations for enterprises to build big data capabilities, promote supply chain flexibility, and further improve enterprise performance.

1.Enterprises should examine the dimension of big data ability as a whole and pay attention to the cultivation and improvement of big data foundation, application and development ability. Through big data capacity building of enterprise value creation and improve enterprise performance, need to strengthen the big data resources available, the strengthened enterprise using big data technology, planning, construction and operation of big data platform, promote the enterprise internal, and real-time data between enterprises and resources integration and sharing, promote the enterprise efficient operation and scientific decision-making, and achieve better economies of scale and scope economy effect. Is more important is the enterprise needs effective organization and use of big data and other complementary resources, to embed the big data fully enterprise operation and management decision making process, implement the business unit, network integration, efficient supply chain system, value and continuous integration and reconstruction of enterprise system, processes and practices, make the enterprise can better adapt to the environment, constantly breaking its inherent practices and patterns, to achieve continuous innovation.

2.Enterprises should pay attention to the flexible construction of supply chain and deal with the relationship between big data capability and supply chain flexibility. Supply chain flexibility plays an important role in the process of big data capability improving enterprise performance. This paper and relevant studies have shown that supply chain flexibility has a significant positive impact on enterprise performance, so enterprises need to actively build and improve supply chain flexibility to improve enterprise performance. In addition, in the process of building the flexibility of supply chain, it is necessary to give full play to the role of big data, that is, to use big data to promote the close coordination and flexible management among supply chain subjects, reduce the bullwhip effect of supply chain, and better meet the needs of customers and the market.

Research Contribution and Future Prospect

The research contribution of this paper lies in that: on the basis of big data capability research, the structural dimensions of big data capability are classified and relevant scales are designed. Previous studies have discussed the value-creation process of big data capabilities from multiple perspectives, including business model innovation, management decisions and enterprise performance. However, few studies have revealed the black box of big data value creation mechanism. Therefore, this study established the influence model of "big data capability → supply chain flexibility →

enterprise performance", and verified the influence of big data capability on supply chain flexibility and enterprise performance as well as the mediating role of supply chain flexibility in it. This research model enriches the existing research on the value creation mechanism of big data and provides ideas for future research.

This paper also has some shortcomings: this paper studies the value creation mechanism process of big data capability from the perspective of supply chain flexibility. However, existing scholars point out that supply chain has the dual characteristics of flexibility and efficiency. Simply emphasizing flexibility while ignoring efficiency will have a negative impact on supply chain performance. Therefore, this paper has some shortcomings in the selection of mediating variables. In addition, the research on big data capability in this paper is mainly focused on the traditional manufacturing industry, but in the real situation, the development and application degree of big data in the Internet industry has been far ahead of the manufacturing industry. In addition, traditional industries such as medical care, retail and finance have also started big data-related applications. Therefore, compared with other industries, the development of big data in the traditional manufacturing industry is not yet mature, which will have a certain impact on the scientificity and universality of this research.

Author Declaration

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