RESEARCH ON THE IMPACT OF BIG DATA APPLICATION ABILITY ON ENTERPRISE INNOVATION PERFORMANCE

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Big data application capability has the cooperation between the upstream, midstream and downstream enterprises of the service supply chain. Big data application capability is regarded as one of the main sources of important organizational capabilities and value creation. It is an important tool to identify the right market positioning, optimize resource allocation, promote the integration of service supply chain, and promote enterprise innovation. It affects the enterprise innovation performance from two ways: the internal and external service supply chain of the organization. This study, based on the theory of resource basis and IT ability theory, attempts to analyze the mechanism of big data application ability of enterprise innovation performance, reveals the intermediary effect of service supply chain integration, added in the model of strategic flexible adjustment, from the dynamic perspective of the ability of big data applications to influence efficiency of enterprise innovation.

Keywords: big data application ability; enterprise innovation performance; service supply chain integration strategy; flexibility

Introduction

With the further development of the economy, the increasingly mature application of big data and other information technologies have had a far-reaching impact on the economic development. Enterprises need not only the productive capacity, but also the ability to apply big data to operate complex and volatile interconnected systems.

The application of big data technology continues to be an important tool for enterprises to actively demand market positioning, mine information resources, optimize resource allocation, promote supply chain integration, and further promote enterprise innovation.
Big data application capabilities in collaboration between upstream, middle and downstream service supply chain enterprises, big data application capabilities are regarded as one of the important sources of its important organizational capabilities and value creation.

If enterprises have strong big data application capabilities to provide connection with other enterprise information system, and in the service supply chain between enterprises and the diffusion, presents a real-time information sharing, real-time sharing ability will greatly improve enterprises to cope with the rapidly changing market and consumer demand, and the ability to seize business opportunities.

Big data application capability is the ability of enterprises to integrate internal and external resources and use big data technologies to collect, store, clean and transform, extract, and analyze, and build commercial big data applications. Big data-driven innovation model is a new opportunity for enterprise development, and will be the next frontier of innovation, competition and productivity.

**Literature review**

With the change in the social experience environment and social generation path, further deepening and personalized and diversified appeal of consumers are becoming more and more obvious, the enterprise experience concept also depends on internal changes, to take into account the close interaction between upstream and downstream enterprises to form an efficient supply chain network, competition between enterprises, supply chains, and more enterprises in the supply chain system basically formed "glory and loss" of community alliance interests.

**Big data application capability**

Big data application capability is the ability of enterprises to integrate internal and external resources to use big data technology to collect, store, clean, transform, extract, analyze, and commercialize big data applications.

At present, enterprise managers and scholars are gradually realizing the full impact of BDA capability on enterprise operation and are trying to construct the connotation and category of BDA enterprise capability from different perspectives. In the study of BDA capabilities impact on enterprise value creation, data resources, operational strategy, and human resources are selected to measure BDA capabilities.

Xie Weihong, Liu Gao, and Wang Tian Painting (2016) have analyzed three types of BDA capabilities from the perspective of dynamic capabilities, namely, resource integration capabilities, in-depth analysis capabilities, and real-time insight and prediction capabilities.

Wamba et al. (2015) see BDA capabilities as an extension of IT capabilities and divided them into infrastructure, project management and human resource capabilities. BDA infrastructure capability is the ability of enterprises to call big data infrastructure to support business operations, which is a collection of BDA resources and big data hardware, software, and network applications.

BDA project management capability is the ability to plan, decide, coordinate, and control big data application projects, while BDA human resources capability emphasizes the technical ability, management skills, business ability and relationship ability of data management professionals.
These three dimensions not only reflect the theoretical inheritance and extension of BDA capability for mature IT capability, but also better reflect the multi-dimensional characteristics such as the complexity, dynamics, and transformability of big data application. Therefore, drawing on the views of Wamba et al. (2015), this paper defines the three main dimensions of enterprise big data application capability: BDA infrastructure capability, project management capability and human resource capability.

**Innovation performance of the enterprise**

Nowadays enterprises are paying more and more attention to innovations, especially the innovations in science-based enterprises can bring new profit growth points to enterprises. The open environment also brings many challenges and many opportunities to the Chinese enterprises.

This environment enables these enterprises to make up for the gap with the developed country companies in a very short time, and directly use the existing technology and relevant knowledge to overcome such a long process of research and development. An innovation is also a process completed by different subjects.

An innovation is the development and application of new ideas created for people who are involved in a transaction in accordance with systemic norms. This definition focuses on the four elements of innovation, namely new ideas, innovation subjects (people), trade, and institutional situations. An innovation can be a new idea, possibly the integration of some old ideas, a scheme challenging the existing order, new rules or unique ways introduced by new added individuals.

An innovation is often accompanied by the elements of technology (Freeman & Soete, 1997) borrow the framework of biological evolution to understand technological changes, believing that an innovation is a reconstructed search process of optimizing technology combination within the scope of technology.

The most classical explanation of innovation comes from (Schumpeter & Nichol, 1934), he believes that innovation is the recombination of factors of production, the establishment of new production indicators, including the production of new products, the adoption of new production methods, the entry into new markets, the use of new industries, raw materials and establishing new organizational methods.

Schumpeter's (1934) definition is more closely related to enterprise practice and enterprise theory research and is widely used and recognized. There are two ways to measure innovation performance: one is an objective measurement, and the other is the development of a subjective perception of the scales.

In the objective measurement method, scientists took different measures at different angles, as shown in Tab. 1.

In terms of subjective measurement, scientists apply the innovation lock effect index rating scale through the subjective perception contrast enterprise participants for the measure, such as Zhang Lanxia, Song Chiayi, Tang Jun (2019), Yanhong & Yuanyuan (2013), scale development, including measuring the effectiveness of the innovation process and innovation results, through the subjective evaluation of the content of the scale as a measure.
The mechanism of big data application ability affecting enterprise innovation performance

Theoretical model of big data application ability influencing enterprise innovation performance

Based on the previous theoretical review and reasoning, our research model is as follows:

Impact of big data application ability on enterprise innovation performance

The development of the Internet has led to a gradual focus on relationships based on the capabilities of information technology, and more and more enterprises hope to increase efficiency through the capabilities of information technology.

Lusch & Nambisan (2015) highlight the capabilities of information technology as both target resources (providing the resources used) and operational resources (resources that promote other businesses and enable productivity).

(Osuszek et al., 2016) point out that technology as an operational resource contributes to advantage and productivity. Information technology capabilities are the combination of organizational information technology resources and tools according to their organizational characteristics to create a heterogeneous ability of enterprises to use information technology, making it difficult for competitors to copy.

Regarding the classification of information technology opportunities, Cousins & Menguc (2006) emphasize that information technology operations can force enterprises to effectively manage their technologies or market opportunities and risks, if an organization can receive possible risk from information technology operations or the use of rules, an enterprise can understand the risk and potential of market opportunities and respond early and enjoy pioneer advantage.
The power of big data provides businesses with a new perspective and a way to accurately segment customers, identify potential needs, and make personalized innovation, and has become an important driving force for enterprise technological innovation, product upgrading and iteration, and process optimization.

Big data enterprise application ability means that enterprises can use a new generation of data management technologies and system facilities to cross-regional, cross-department long-scale semi-structured and unstructured data, make data acquisition, transfer, analysis and application of data combined with enterprise operations, reducing the uncertainty and complexity of decisions, improving the understanding and actions of the enterprise (Osuszek et al., 2016).

At the same time, enterprises with big data professionals can give full use of their experience, management skills, business capabilities and collaborative spirit to provide enterprises with knowledge and skills to import big data management and make innovative decisions (Opresnik & Taisch, 2015).

Finally, enterprises with strong big data application ability have solid experience in big data project planning and cross-organization coordination experience, and can use big data technology to achieve more effective communication and collaboration between organizations, continue to improve business processes, jointly predict the potential market demand, develop competitive innovative products and quickly promote them to a new market. Thus, the possibility of using big data has a significant positive impact on the efficiency of enterprise innovation.

Impact of service supply chain integration on enterprise innovation performance

In the relevant research on the impact of service supply chain integration on the organization, the supply chain integration as an independent variable must be measured through reasonable dimensions. Therefore, many researchers have made many attempts and generalizations to measure the separation of supply chain integration. As can be seen from the following table, there are many ways and categories of measurement of service supply chain integration, and there are certain overlaps and repetitions between them.

However, we can point out three dimensions: customer integration, supplier integration and internal integration.

Based on the above dimensional division table of supply chain integration, we can see that there are roughly three types of research on the relationship between supply chain integration and enterprise performance: the first is internal integration and enterprise performance; the second is external integration and enterprise performance; and the third is external integration and internal integration and enterprise performance.

Enterprise service innovation requires continuous and large-scale resource input. Resource integration across organizations, especially for suppliers, can help service integrators gain access to key and complementary resources.

Lusch & Nambsan (2015) emphasize that service innovation takes place in the collaborative process of players and networks of players, and that the integration of resources involving different players is the fundamental way to achieve innovation.

Vargo et al. (2015) emphasized that innovation is the combinatorial evolution of useful knowledge in the service ecosystem. It can be said that resource integration is the basic approach to innovation. Therefore, service innovation is a collaborative process involving the
resource integration of network system participants (Lusch & Nambisan, 2015; Saviano et al., 2017).

**Table 1 - Division and comparison of supply chain integration dimensions**
(made by the author)

<table>
<thead>
<tr>
<th>Investigator</th>
<th>Dimension of supply chain integration</th>
<th>Organizational performance</th>
</tr>
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<tbody>
<tr>
<td>Armistead &amp; Mapes (1993);</td>
<td>Supply Chain Integration (SCI)</td>
<td>Operational performance; competitiveness and operating performance, after-sales service and financial performance;</td>
</tr>
<tr>
<td>Rosenzweig et al. (2003);</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frohlich &amp; Westbrook (2001);</td>
<td>Customer integration, internal integration, vendor integration, technology, and plan measure consolidation</td>
<td>Overall logistics performance; market performance, product performance and non-product performance; regulating the relationship between international market / product and enterprise performance;</td>
</tr>
<tr>
<td>Ragatz et al. (2002);</td>
<td>Supplier integration</td>
<td>Period duration; project team performance, enterprise financial performance, and design performance;</td>
</tr>
<tr>
<td>Petersen et al. (2005);</td>
<td></td>
<td></td>
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<tr>
<td>Cousins &amp; Menguc (2006);</td>
<td></td>
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<tr>
<td>Morash &amp; Clinton (1998);</td>
<td>Internal integration, external integration</td>
<td>Total cost reduction and differentiation strategy; process efficiency and procurement leverage; logistics and financial performance</td>
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<tr>
<td>Saeed et al. (2005)</td>
<td></td>
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More studies have confirmed the positive role of supply chain integration on enterprise performance (Rahinan, 2013; Changli et al., 2016) believe that supply chain integration directly promotes enterprise non-financial performance.

In addition, Aal et al. (2016) emphasized that resource integration across service system boundaries helps to achieve service innovation.

Participants in the service ecosystem integrate their resources through service exchange to promote service innovation (Lusch & Nambisan, 2015; Aal et al., 2016).

In the service supply chain system, the center integrator is closely related to the resource integration and performance of the service providers.

Thus, Service supply chain integration can positively affect enterprise innovation performance; Internal integration of service supply chain can positively affect enterprise innovation performance; Supplier integration of the service supply chain can positively affect the enterprise innovation performance; Customer integration of the service supply chain can positively affect the enterprise innovation performance.
Impact of big data application capabilities on service supply chain integration

Big data application capability mainly includes two aspects: knowledge of software related to solving practical problems: knowledge of hardware such as devices and tools used by to solve these practical problems.

The sum of the two constitutes the technical resources of the organization. Enterprises can develop big data and other technologies to make themselves in a favorable position to compete with competitors. At the same time, organizations need to train and enhance their big data application capabilities to support their service supply chain integration and thus improve their service supply chain performance.

The research of Ross et al. (1996) and Melville et al. (2004) has divided information technology human resources into four dimensions: professional ability, project operation ability, management ability, and relationship ability.

Enterprises can rely on its big data application ability to promote supply chain integration, reflected in three aspects: first, promote information sharing, such as the use of things technology can quickly obtain sales, inventory, production, and distribution data and sharing between each node enterprises, eliminate cooperation information asymmetry, so as to help the maintenance of long-term collaboration (Choi & Shen, 2016).

Second guarantee joint decision-making, enterprises can use the huge data resources, through big data analysis technology insight into market demand and user changes, and other partners on the supply chain product and business process innovation, and suppliers and manufacturers according to the fluctuation of supply chain demand to achieve joint inventory and manufacturing on time, to improve the overall operation efficiency of supply chain (Juying & Quanchao, 2014).

Finally, build incentive alliances. The application of big data resources breaks the sharing barriers among the supply chain enterprises, closely combines the vertical alliance with the supply chain as the link, and effectively promotes the establishment of the alliance organizations with benefit sharing, risk sharing and coordinated development through the dynamic contract system and the reasonable benefit distribution mechanism.

Considering the above analysis, big data application capabilities may have a positive impact on service supply chain integration.

Therefore, Big data application capabilities can positively affect the service supply chain integration: Big data application capabilities can positively affect the internal integration; Big data application capabilities can positively affect supplier integration; Big data application capabilities can positively affect customer integration.

Intermediation effect of service supply chain integration

With the continuous accumulation of enterprise data resources and big data technology gradually mature, data-driven collaborative mode gradually become the main operation mode of supply chain ecosystem (Zhiyan, 2013) and the integration of data resources and effective use depends on good synergy between members, only by improving the quality of the relationship between members, enterprises can in business coordination and communication, identify evaluation innovation opportunities, absorb innovation knowledge, integration of complementary resources, eventually improve innovation performance (Ke et al., 2015).

The evaluation of enterprise innovation opportunities requires large data resources to provide decision support. Big data applications not only provide infrastructure for acquiring, storing and sharing partners in the supply chain huge amounts of data, but also insight market
demand and customer changes in real-time, to provide rich reference information for joint decision between enterprises, thus promoting product and service innovation, operation process innovation, management system innovation and business model innovation (Schoenherr & Speier-Pero, 2015; Gunasekaran et al., 2017).

Based on the above analysis, this paper believes that the application capability of big data will further improve the innovation performance of enterprises by improving the supply chain integration.

**Regulatory effect of strategic flexibility**

Strategic flexibility is the ability of enterprises to restructure organizational resources, processes, and strategies to respond to environmental changes (Sanchez R, 1995).

It consists of resource flexibility and coordinated agility. Resource flexibility reflects the potential use of the resources, such as time and cost of resource transformation; the flexibility of coordination reflects the ability of an organization to use resources efficiently, concentrating the attention on defining, building, and configuring existing resources, on the ability to synthesize and reorganize routines to support enterprise strategy (Matthyssens & Pauwels, 2005).

Strategic flexibility adjusts the relationship between big data application ability and enterprise innovation performance.

First of all, the strategic flexibility strengthens the positive influence of the big data with the increase of strategic flexibility. The potential application of internal knowledge expands, enterprises can enhance resource positioning, identification and deployment quickly and at low cost. It can also improve resource allocation efficiency, speed up the adaptive response and problem solving.

Strategic flexibility enables enterprises absorb and use new knowledge better as well as improve the potential for exploratory innovation and evolution reconstruction (Yang et al., 2016), the following assumptions: strategic flexibility plays a positive role in regulating the possibilities of using big data for enterprise innovation.

**Conclusion**

This article explores the mechanism of using big data for the innovative activity of an enterprise. A clear correlation between the two has been found in the literature and theoretical studies. the literature and theoretical studies.

But we also see that there are also intermediaries and regulating factors that play a clear role between them. The specific findings from our study are as follows: first, the possibility of using big data has a significant positive impact on the effectiveness of enterprise innovation.

Secondly, the integration of the service supply chain can positively affect the efficiency of enterprise innovation; internal integration of the supply chain of services can positively affect the efficiency of enterprise innovation; supplier integration of service supply chain can positively affect enterprise innovation performance; customer integration of service supply chain can positively affect enterprise innovation performance.

Third, the capabilities of big data applications can positively influence service supply chain integration; the capabilities of big data applications can positively impact internal
integration; the possibility of using big data can positively influence the integration of suppliers; big data application capabilities can positively impact customer integration.

Fourth, the capabilities of big data applications can influence the effectiveness of innovation through internal integration; big data applications can affect innovation performance through supplier integration; and big data application capability can affect innovation performance through customer business integration.

Finally, strategic agility plays a positive role in regulating the ability of big data applications to influence enterprise innovation performance.

In short, although we have tested the mechanism by which the possibility of using big data affects the efficiency of enterprise innovation, there will still be big problems in future research, since the influencing factors will change over time in different environments.

References:


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