Analysis on the Strategic Alliance Cooperation Game under the Background of Big Data

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Abstract. Based on the alliance combination phenomena at home and abroad, the paper builds an alliance cooperation model of three types of enterprises in the context of big data, designs to provide a reference framework for enterprises. This paper uses decision tree analysis to address the cooperative relationship between focus enterprise and the cooperative one. When the three types of enterprises to be focus one, respectively, we study the benefits of the other two enterprises and do comparison. As result, in the term of its best benefits, the focus enterprise select cooperation as long as its expect benefits are bigger, then the cooperative one choose to cooperate if only it has benefits.

Introduction

Strategic alliance has been a lot of attention, since it came out. In the dynamic and complex context, strategic alliance aims at seizing market opportunities and seeking technology; human; and information resources across the globe, and continuously improving their ability to complement the use of resources and a shortage of resources, to obtain greater benefits that their own cannot be achieved. Strategic alliance can achieve the purpose which a single enterprise cannot do, it can also provide more resources and knowledge for the alliance parties. It make the alliance parties can offer more value for the customers, therefore, this type of organization quickly becomes the most popular form that the most enterprises are seeking.

With the advent of big data, government; business; and academia are subject to significant influence. In particular, big data has been successful commercial applications. Amazon's commodity recommendation system; Google's Flu forecast; Farecast's ticket prices forecast; Retailer Target's pregnancy merchandise forecast; Wal-Mart's bundling tart with flashlight; etc, these fully reflect the commercial value of big data. Wide application of big data and related technologies, it is noticed by the government; experts; and scholars of domestic and abroad. Various countries are increasing emphasis on the development and application of big data. March 2012, the Obama administration released 200million investment in big data special research program, it rises big data on a strategic national level. So far, it has implemented three policies, and opened up more than 50 categories. January 2013, NIST held a joint forum and seminars on cloud and big data. In the UK, the government invested more than 10 thousand pounds to establish ODI, to strengthen the cooperation among the government; enterprises; researchers; and the public, and to promote the better use of data by enterprise and the public. December 2012, ESTY commissioned by the European Commission, discussed the needs of cloud standards. July 22th, 2012, The first forum of Chinese big data application was held at Peking University, it discussed the development trend of big data; cloud computing and big data; big data and business intelligence; and different scenes of big data applications. In 2015, Chinese national economic and social development of the thirteenth five-year plan proposed

the big data strategy. Fifth Plenary Session has mentioned that implementing the national strategy of big data and promoting open sharing of data resources.

To confront with complex and volatile external environment, strategic alliance enterprise's decision making; marketing channels; business models; the access to the information; information processing capability etc, are subject to significant influence. Enterprises come to join the alliance is not only for accessing to resources of other members, but also for the realization of shared data resources and mining the huge value in the data. So far, most scholars study the influence of big data on a single enterprise, and less attention on the partnership in the strategic alliance. Therefore, the paper will examine the impact of big data on the cooperative relations between alliance enterprises.

Research Status

Definition and Characteristics of Big Data

May 2011, the McKinsey Global Institute published the famous report *Big Data: innovation, competition and the next frontier productivity*, and first proposed the concept of big data. McKinsey suggested that big data referred to the data set that could not be collected; stored; managed; and analyzed through conventional database software tools within a certain period of time. Wikipedia defined big data as the huge amount of data that could not scale to the current main software tools and reach the capture; management; processing; and finishing to help business decision-making. Gartner argued that big data referred to high growth rates and diverse information assets which needed for new processing mode in order to have more decision-making power; insight found force; and massive process optimization capabilities. IDC believed that big data generally related to data in the form of two or more, to collect more than 100TB of data, and high-speed real-time data streams, or small data began the annual growth of more than 60%. Chinese Academy of Engineering, chief scientist of Institute of Computing Jie-li Guo had a such interpretation: in general, big data referred to data collection that could not perceived; acquired; managed; processed; and served by traditional IT technologies; hardware and software tools within a tolerable time. Big data affected not only academia, but also the industry. Informatical China, Chief Product Counselor, Bin Dan thought that big data equals to mass data plus complex data, and further noted that big data included transaction and interaction data sets, their size or complexity beyond the capability to capture; manage; and process with the common techniques in a reasonable cost and time. The general manager of NetApp in China, Chen considered that big data meant the way of accessing to information to do things became different, and thus achieved a breakthrough. Big data includes Big Analytic, Big Bandwidth and Big Content. According to comprehensive domestic and foreign research on the concept of big data, it is data collection that could not use traditional techniques and software tools for storage analysis, and include a large number of semi-structured data and unstructured data.

At present, Academia has unified understanding on the characteristics of big data: volume, variety, velocity, value. From the composition point of view, big data generated by structured data(such as financial system; personnel system; ERP; etc), semi-structured data(such as news; e-mail; etc) and unstructured data(such as mobile terminals; sensors; social network generated data; etc).

Strategic Alliance of Domestic and Abroad

After DEC's president Jean Hopland and famous management scientist Roger Niger proposed strategic alliance concept, many scholars study strategic alliance from different angles.

Teece (1992) proposed that strategic alliance referred to two or more separate enterprises that carried out cooperative activities characterized by commitment and trust, for realization of complementary advantages of resources and sharing etc. Yoshino & Rangan (1995) believed that strategic alliance were two or more enterprises by providing mutual skills; technology; and products etc, to form a connection between a particular business. Porter (1996) considered it as middle marginal organizations between market transactions and bureaucratic organizations, and it could be regarded as corporate governance structure under incomplete contract. Gulati (1998) argued that strategic alliance between the enterprises was a series of horizontal and vertical interwoven social networks based on their own purposes. Pyka & Windrum (2003) suggested that strategic alliance was a kind of cooperation or cooperative agreement of two or more enterprises in pursuit of common goals; solving common problems in a sustained period of time. Although different scholars elaborate inconsistent, they all reflect that strategic alliance is cooperation between enterprises; alliance enterprises maintain their independence; and cooperation may be in the part field of business.

Alliance always has been academic attention. Scholars research alliance-related issues from different perspectives. Many scholars use the theory of transaction cost; resource-based; etc, to explain the motives and causes of alliance. Some scholars explain the phenomena of coalition formation from cost-revenue perspective. Yi Zhang studied the dynamic game of enterprises that cooperate with productive enterprises or RJV based on cost-revenue perspective under conditions of incomplete information. Cui-hua Wu studied the formation mechanism of process of cooperation between enterprises in dynamic context. It is found that the main reason for enterprises to join the alliance is to share resources and risks. With the rapid development of cloud computing and big data, reason of the enterprises constitute the alliance has also some changes.

In big data, strategic alliance provides not only technology; products; etc, but big data and the potential value. In the context of big data, the border between enterprises and dynamic environment has been increasingly blurred, information sharing and knowledge spillover will be the main way of its co-opetition and co-evolution. In such a competitive background, data information and knowledge become an important factor for production, and the key to deciding innovation. Based on big data platform and social networks established by alliance enterprises, to obtain valuable information and knowledge from alliance partners is key to competitive advantages and improving alliance status. The social networks established by big data platform, accelerate the speed of information dissemination; promote the spillovers of strategic alliance; and make alliance enterprises get more useful resources. So the enterprises with big data of domestic and abroad are favored, such as IBM, Intel, Amazon, Microsoft, Google, Alibaba, baidu, Tencent, Huawei, Langchao, etc.

With the widespread application of big data and related technology, phenomena of enterprise mergers other ones or cooperates with enterprise with big data are increasing. March 28th, 2013, BGI, Tencent, Huawei and other 15core units set up big data and research alliance in Shenzhen, it absorbed core enterprises in big data industry; universities and research institutions to establish a common technology and service platform. November 4th, 2014, the Eastern Airlines; Telecommunications;

Easy car; Asiainfo; etc, established China Enterprise Big Data Alliance in Beijing with 45 joint enterprises. IBM bought the enterprise Stored IQ, because its software could provide large analysis and governance for different and scattered emails; file sharing; and collaboration sites.

This shows that the enterprises consider big data resources and technology as an important factor in the choice of alliance partners. The enterprise that has big data or its technology are more popular.

Cooperative Game Analysis of Strategic Alliance

Big data is a means of production, and also the next frontier of competition; innovation; and productivity. It is a new wealth hidden in huge value. According to McKinsey survey, big data has been a basic resource for production together with capital and labor, and it can create value. It also becomes a key factor in competition and growth of enterprises. Although big data is in line with core capability, but even with more big data resources, it does not mean to establish competitive advantages, they also need in-depth processing capabilities and the ability to develop products or services. The enterprise that has big data resources and related technology get more competitive advantages. Based on this, the paper will divide into four types according to whether it has big data resources or technology: double-none enterprise (refers to the enterprises has neither resources nor technology), enterprise with big data resources, enterprise with big data technology, double-owned enterprise (refers to the enterprise has both resources and technology). When study alliance partnership, it should be based on the wishes of focus enterprise and partners, and bilateral or multilateral co-existence of authenticity.

By client, etc, collecting data will take a certain cost, and the cost of analysis; sorting data; mining the value by big data technology is more. The double-owned enterprises, such as Alibaba, Amazon, etc, can use their own technology to mine the value behind the data, so they are core of alliance. The enterprises with big data resources need to buy the technology or give them to enterprises with big data technology if they do not cooperate with double-owned or the ones with technology, and it can be a cost. The enterprises with big data technology need to collect information if they do not cooperate with double-owned or the ones with resources, and it also can be a cost. With respect to the other three types, double-none enterprises cost most when cooperate with other three types. The double-owned enterprises has less cost than the other three types in cooperation, so this paper focuses on the partnership between the three types.

Parties

Suppose that alliance has two parties, they are focus enterprise and cooperative enterprise. For convenience, the focus enterprise and cooperative enterprise are belong to the three types, and different from each other. Focus enterprise and cooperative enterprise are respectively denoted by F and C. We have: F={double-none, big data resource, big data technology}, C has the same factors, and they have condition: $F \neq C$.

Strategic Choice

In the game, the each party has two strategies:' cooperation and non-cooperation. The parties' action set is denoted by S, which is the following equation.

$S = \{s\} = \{\text{cooperation, non-cooperation}\}$.

Payment Functions

Whether the enterprise operating alone, or co-operation, both ways can generate benefits. According to the business benefits, to establish payoff matrix to represent a combination of bilateral cooperation, namely payment functions, it denoted by V. The three types enterprises, that is double-none, big data resources, big data technology, get respectively R_1, R_2, R_3, when they operate alone. In cooperation between double-none and big data resources, they get respectively w_1,w_2, they cost respectively c_1,c_2. In the alliance between double-none and big data technology, they get w_1',w_3, and cost c_1',c_3 . In the last cooperation between big data resources and big data technology, they get w_2', w_3', and cost c_2', c_3'.

Model Building

The focus enterprise is double-none

When the focus is double-none, the cooperative one is big data resources or big data technology. Based on the above assumptions, there are following payment functions:

For focus enterprise, see the following Equations (1)-(3):

$$V_F(\text{non}-\text{cooperation}) = R_1 . \quad (1)$$

$$V_F(\text{big data resources, cooperation}) = R_1 + w_1 - c_1 . \quad (2)$$

$$V_F(\text{big data technology, cooperation}) = R_1 + w_1' - c_1' . \quad (3)$$

For cooperative enterprise, see the following Equations (4)-(7):

$$V_C(\text{big data resources, non-cooperation}) = R_2 . \quad (4)$$

$$V_C(\text{big data resources, cooperation}) = R_2 + w_2 - c_2 . \quad (5)$$

$$V_C(\text{big data technology, non-cooperation}) = R_3 . \quad (6)$$

$$V_C(\text{big data technology, cooperation}) = R_3 + w_3 - c_3 . \quad (7)$$

All variables are greater than zero.

Information between the focus one and cooperative one traditionally is asymmetric, that is the one cannot get complete information of other ones. With the advent of big data, the enterprises have more convenient way to access to the information, and they become transparent, that reduces the asymmetry of information. But the current research has not completely eliminated the information asymmetry. Thus, the paper assumes that the one with big data resources chooses to cooperate with probability P, and the big data technology with probability P'. We get *figure 1*:

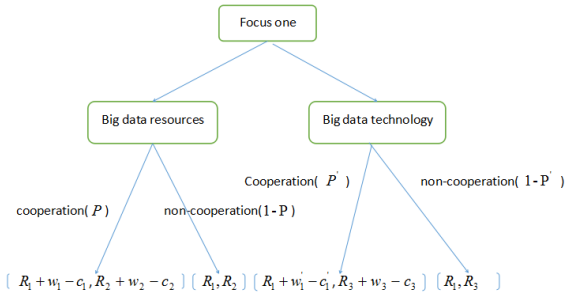

Figure 1: double-none decision tree

At this point, the focus one get expected benefits are respectively following equations (8)-(9):

$$E_1 = P(R_1 + w_1 - c_1) + (1-P)R_1 = R_1 + P(w_1 - c_1). \quad (8)$$

$$E_2 = P'(R_1 + w_1' - c_1') + (1-P')R_1 = R_1 + P'(w_1' - c_1') \quad . \quad (9)$$

WhenE_1>E_2, focus one tends to choose the one with big data resources, and when E_1<E_2,focus one tends to choose the one with big data technology.

At this time, the one with big data resources and the other have expected benefits, which is following equations (10)-(11):

$$E_3 = P(R_2 + w_2 - c_2) + (1-P)R_2 = R_2 + P(w_2 - c_2). \quad (10)$$

$$E_4 = P'(R_3 + w_3 - c_3) + (1-P')R_3 = R_3 + P'(w_3 - c_3). \quad (11)$$

Whenw_2>c_2, the one with big data resources tends to choose cooperation, and when w_3>c_3, the one with big data technology tends to choose cooperation.

The focus enterprise is the enterprise with big data resources

When the focus is the enterprise with big data resources, the cooperative one isdouble-none or big data technology. Based on the above assumptions, there are following payment functions:

For the focus one, see the following Equations (12)-(14):

$$V_F(\text{non}-\text{cooperation}) = R_2. \quad (12)$$

$$V_F(\text{double-none, cooperation}) = R_2 + w_2 - c_2 \quad . \quad (13)$$

$$V_F(\text{big data technology, cooperation}) = R_2 + w_2' - c_2'. \quad (14)$$

For the cooperative enterprise, see the following Equations (15)-(18):

$$V_C(\text{double-none, non-cooperation}) = R_2. \quad (15)$$

$$V_C(\text{double-none, cooperation}) = R_1 + w_1 - c_1 \quad . \quad (16)$$

$$V_C(\text{big data technology, non-cooperation}) = R_3 \quad . \quad (17)$$

$$V_C(\text{big data technology, cooperation}) = R_3 + w_3' - c_3'. \quad (18)$$

All variables are greater than zero.

Assume that the one with double-none chooses to cooperate with probability P_1, and the big data technology with probability P_1'. We get *figure 2*:

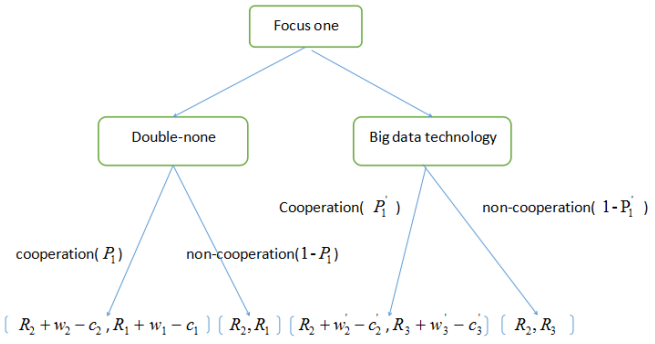

Figure 2: decision tree of big data resources

At this point, the focus one get expected benefits, which is following equations (19)-(20):

$$E_1' = P_1(R_2 + w_2 - c_2) + (1-P_1)R_2 = R_2 + P_1(w_2 - c_2). \quad (19)$$

$$E_2' = P_1'(R_2 + w_2' - c_2') + (1-P_1')R_2 = R_2 + P_1'(w_2' - c_2'). \quad (20)$$

When E_1'>E_2', focus one tends to choose the one with double-none, and when

$E_1^{'}<E_2^{'}$, focus one tends to choose the one with big data technology.

At this time, the one with double-none and the other have expected benefits, which is following equations (21)-(22):

$$E_3^{'} = P_1(R_1 + w_1 - c_1) + (1 - P_1)R_1 = R_1 + P_1(w_1 - c_1)\,. \tag{21}$$

$$E_4^{'} = P_1^{'}(R_3 + w_3^{'} - c_3^{'}) + (1 - P_1^{'})R_3 = R_3 + P_1^{'}(w_3^{'} - c_3^{'})\,. \tag{22}$$

When$w_1>c_1$, the one with double-none tends to choose cooperation, and when $w_3>c_3$, the one with big data technology tends to choose cooperation.

The focus enterprise is the enterprise with big data technology

When the focus is the enterprise with big data technology, the cooperative one is double-none or big data resources. There are following payment functions:

For the focus one, see the following Equations (23)-(25):

$$V_F(\text{non}-\text{cooperation}) = R_3\,. \tag{23}$$

$$V_F(\text{double-none, cooperation}) = R_2 + w_2 - c_2\ . \tag{24}$$

$$V_F(\text{big data resources, cooperation}) = R_3 + w_3^{'} - c_3^{'}\ . \tag{25}$$

For the cooperative enterprise, see the following Equations (26)-(29):

$$V_C(\text{double-none, non-cooperation}) = R_1\ . \tag{26}$$

$$V_C(\text{double-none, cooperation}) = R_1 + w_1^{'} - c_1^{'}\,. \tag{27}$$

$$V_C(\text{big data resources, non-cooperation}) = R_2\,. \tag{28}$$

$$V_C(\text{big data resources, cooperation}) = R_2 + w_2^{'} - c_2^{'}\ . \tag{29}$$

All variables are greater than zero.

Assume that the one with double-none chooses to cooperate with probability P_2, and the big data resources with probability $P_2^{'}$. We get *figure 3*:

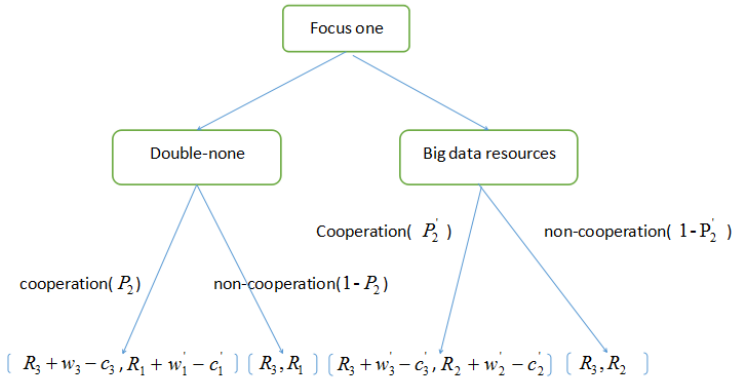

Figure 3: decision tree of big data technology

At this point, the focus one get expected benefits, which is following equations (30)-(31):

$$E_1^{''} = P_2(R_3 + w_3 - c_3) + (1 - P_2)R_3 = R_3 + P_2(w_3 - c_3)\ . \tag{30}$$

$$E_2^{''} = P_2^{'}(R_3 + w_3^{'} - c_3^{'}) + (1 - P_2^{'})R_3 = R_3 + P_2^{'}(w_3^{'} - c_3^{'})\ . \tag{31}$$

When $E_1^{''}>E_2^{''}$, focus one tends to choose the one with double-none, and when $E_1^{''}<E_2^{''}$, focus one tends to choose the one with big data resources.

At this time, the one with double-none and the other have expected benefits, which is following equations (32)-(33):

$$E_3^{''} = P_2(R_1 + w_1^{'} - c_1^{'}) + (1 - P_2)R_1 = R_1 + P_2(w_1^{'} - c_1^{'}) . \quad (32)$$

$$E_4^{''} = P_2^{'}(R_2 + w_2^{'} - c_2^{'}) + (1 - P_2^{'})R_2 = R_2 + P_2^{'}(w_2^{'} - c_2^{'}) . \quad (33)$$

When $w_1^{'} > c_1^{'}$, the one with double-none tends to choose cooperation, and when $w_2^{'} > c_2^{'}$, the one with big data resources tends to choose cooperation.

Conclusion

The paper analyzes the partnership between alliance enterprises by game analysis. The study divides the object into four types, and emphasizes the cooperation of the three types, namely enterprises of double-none, big data resources and big data technology, and builds a model of cooperation between the three types of enterprise. The study finds that the focus one chooses the partner that gives it more expected benefit, and the cooperative enterprise chooses to join when the benefit is greater than the cost.

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