

The Game Analysis about Government-Industry-University-Institute Alliance of Competitive Intelligence

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Abstract

In this paper, a three-player game model is proposed to study the interactive relationship and game status among governments, enterprises and university-institute by using the game theoretical analysis, obtains eight possible pure strategies Nash equilibrium, carries out analysis about pure strategies equilibrium and mixed strategies equilibrium, discusses earnings of the main alliances parties about choosing to cooperate and not cooperate, offers some possible suggestions about the main alliances parties. It is a good reference to offer policy decisions about constructing and operating government-industry-university-institute alliance of competitive intelligence.

Keywords: government-industry-university-institute; competitive intelligence; strategic alliance; three-player game

1. Introduction

With the rapid development of technology and economy, the market competition is becoming increasingly fierce, if the enterprises make decisions, they must constantly focus on their rivals, the external competitive environment and industry competition landscape, so for the business strategic decision-making, it is critical to get effectively and valuable competitive intelligence. And enterprises must try to cooperate with the governments, universities and research institutes and establish government-industry-university-institute strategic alliance of competitive intelligence. we rely on the power of alliances so that not only we can get a lot of business competitive intelligence which the enterprises need, but also we can enhance the competitive advantages, thus promoting corporate sustainable development. From the theoretical analysis, due to the governments, universities and research institutes are short of the understanding of the market information, in different degrees, the markets lack sensitivity enough. thus three parties have a aim to cooperate with the enterprise. Building government-industry-university-institute strategic alliances of competitive intelligence can not only effectively integrate resources, and can fully realize their functions about alliance parties. In the course of the strategic alliance, the governments can regulate market behavior to achieve their night watchman function. In the course of research cooperation under the coordination and supervision of the normal operation of the government, which not only achieve the efficient allocation of resources, and ensure stable operation of the market activity. The universities and research institutes have a large number of professional and talented researchers, not only can help companies quickly and efficiently obtain relevant and competitive intelligence about market information, and coordinate the enterprises undertake the preliminary basic research, develop some scientific research results, but also you can train a large number of qualified talents. with the scope of government regulation, the enterprises can achieve industrialization of research achievements and create a lot of jobs and create social wealth and promote economic development. So building government-industry-university-institute strategic alliance of competitive intelligence, not only can develop competitive intelligence resources, rich competitive intelligence perspective about alliance parties, but also can provide a new strategic methods and tools for businesses, accordingly promoting the sector decision-making efficiency.

However, in the course of building government-industry-university-institute strategic alliance of competitive intelligence, because the coalition parties must provide their own survival core of intelligence, so that it will probably make themselves lose some competitive advantages, particularly when individual interests and the interests of the alliance start to have some contradictions, the alliance parties will often set in order to ensure their own interests and ignore the interests of the league, leading to the cooperation can't continue.

For example, in the course of the enterprise cooperation, in the aim of strategic alliance development and technological innovation, enterprise may conceal some core intelligence information to the members of the League, and even stop continue to cooperate, which will greatly harm the interests of related parties, leading to the governments, universities and research institutes occur mistakes in boosting industrialization process, resulting in a deviation from the market demand because the government formulates industrial policy, universities do not meet the market demands to develop some intelligence personnel, the research institutes do not develop some industrialization research results. Similarly, in the alliance process of universities and research institutes, they may worry about their own patented technologies or innovations have been stolen, and take a conservative approach, which is extremely unfavorable to the application and promotion of products and patented technologies, resulting in the production out of low awareness of products. While the governments choose to ignore some market irregular behaviors in order to avoid paying the cost of supervision and restraint, there is no mechanism to formulate to restrict and stop the irregular market behaviors, causing market disorder. For deeply analysis of the interaction about government-industry-university-institute strategic alliance competitive intelligence, exploring the establishment mechanisms of long-term government-industry-university-institute strategic alliance competitive intelligence, promoting the overall interests of the alliance is greater than the benefits gained their independence and ensuring the course of cooperation can run successfully. From the game theory, this paper will use competitive intelligence official game analysis, the aim is to seeking appropriate strategic alliances to meet the interests of all parties.

2. Literature Review

Game theory was originated in 1944, Neumann and Morgan Stein published the paper named "Game Theory and Economic Behavior", mainly used to analyze complex economic life problems about the conflict of interests. Today, due to the explanation of game theory in complex economic systems and management issues has a very unique part, therefore it is widely used in the social sphere, it has become an important means of competitive intelligence research to use the game theory to explain the interests of the alliance parties and make the main competitive intelligence strategy^[1]. According to look up some relevant literature, about the intelligence of the game has long been attracted widely attention at home and abroad theorists. Currently, researches about game theorists have a more in-depth information, research results are more fruitful. Sue Myburgh pointed out that competitive intelligence is the key to enterprise development, for enterprise, it's the primary prerequisite to make strategic decisions. strategic decisions under competitive intelligence is a dynamic game process^[2].

After the 1990s, Chinese scholars Zhang Weiyang, Shi Xiquan introduced the game theory, such as the knowledge and analytical framework came after the introduction and presentation, game theory is widely used in the analysis of information economics^[3-4]. In 1999, Mao Jun applied game theory research in the field of intelligence in the first time. through the history of the introduction of game theory, the introduction of the prisoner's dilemma, pointing the impact of competitive intelligence on Equilibrium^[5]; Dong Xing Yu and Wu He Xing analyzed the game features about new competition in the market and the roles and characteristics of information in the course of the game, pointed out the game process based on intelligence analysis^[6]; Hu Xu discussed the role of competitive intelligence in game theory from the relationship between game theory and competitive intelligence and analyzed Competitive Intelligence Activities by game theory^[7]; Pei Lei studied Library and Information academic application of game theory from 1998 to 2006, analyzed the integration process through the concept of library and information research and game theory^[8]; Hua Yao and Cui Yuan analyzed the dynamic game process about "Competitive Intelligence event" and "strategic decision makers" from the point of view of the dynamic game and discussed how to use the decision-making model program^[9]; Sun Li analyzed the necessity for anti-competitive intelligence by using the knowledge of game theory, noted that anti-competitive intelligence was an incomplete information dynamic game process of non-cooperation^[10]; Song Jie Kun and Zhang Yu analyzed the necessity of enterprise competitive intelligence cooperation through the use of the Prisoner's Dilemma model, building Competitive Intelligence enterprise collaboration cost sharing model, using a combination of linear programming model to integrate the results of four models^[11].

In summary, many scholars have to expand the study of the theory and practice about competitive intelligence-related issues from many aspects, but most studies mainly focus on competitive intelligence to expand the content itself, there is little theoretical studies commenced production of official government-industry-university-institute strategic alliance competitive intelligence research theory and strategic alliances operating mechanism.

This paper intends to combine with the universities and institutes, then building three game models about enterprises and governments and universities and institutes by using the basic knowledge of the game theory, then start to analyze the game theory about strategic alliances and come up with some suggestions. Through the research, not only theoretically rich theoretical knowledge and the development of competitive intelligence, but also provide a reference to implement the strategic alliance of competitive intelligence and promote to conduct competitive intelligence work.

3. Tripartite Cooperation Three Game Parties, Business and Government Supervision Departments

3.1 Cooperative Game Participants

In theory, building strategic alliances of competitive intelligence need the governments, enterprises, universities and research institutes engaged and noticed. In the process of government-industry-university-institute strategic alliance competitive intelligence, participating in the game are the governments, enterprises, universities, research institutes. Because universities and research institutes form a strategic alliance motives and interests, and other factors are very similar, fully universities and research institutes can be combined as one body, so really members about participating in competitive intelligence: official (government), production (corporate), Gakken (universities and research institutes). The following features expand on the above analysis of the main parties involved:

At first, governments, as a game participant, in the process of government-industry-university-institute strategic alliance of competitive intelligence, it is mainly responsible for the supervision and constraint functions, to provide a good external environment for research cooperation, and supervise and restrain some irregular behavior in the cooperation process, thus ensuring the cooperation process continue. The role of government is mainly to develop codes of conduct of some market research to ensure that all parties will abide by the order, to maintain the development of the market, in the process of cooperation, if the company or Gakken parties harm the interests of the union in order to protect their own interests, the government will be supervised and punished. For the government, although it will pay a certain cost in monitoring and regulating, but under the premise advocate research cooperation, the successful implementation of competitive intelligence and research-based strategic alliance will bring direct and indirect benefits for governments.

Secondly, the enterprises, as a major player in the game, the main aim is to achieve the objective of maximizing the economic benefits, the main purpose of the participation and cooperation of intelligence personnel and the use of Information Technology Gakken party and developed in line with market demands and have a potential market value of intelligence products, enable enterprises to gain competitive advantage in the fierce market competition, to promote sustainable development of enterprises. As market players in business, it has the information advantage, but the universities and institutes don't have. It can through their own available information and data to understand the changes in market demands, making full use of intelligence personnel and technical supports, to filter out from the mass of information valuable competitive intelligence, relying on universities and research institutes in research and innovation capacity, the valuable intelligence information into the needs of the real products.

Finally, universities and institutes are also important participants of the game. Different from the enterprises want to pursue the maximize interests, universities and institutes mainly assume the jobs about personnel training, knowledge, innovation and basic research. It's will be mainly pre-industrialization and infrastructure work. Universities and institutes not only need the state financial support, but also need cooperate and supports to the enterprises and optimize its own basic research and personnel training in the external conditions. Meanwhile, because of lacking of understanding of market demands, resulting in its R & D results and developing talents and market demands derailment, therefore, for the universities and institutes, they need the platform edge companies, a clear understanding of the social reality of the demand for talents and technology, which better to integrate their research into real products to achieve their economic value.

3.2 Build Cooperative Game Model

Assume 1 In a process of government departments decide to regulate the cooperation members, it will cost C_1 , the probability is P_1 , government participation in the process of the game will get not only the economic benefits (tax) R_1 , you can also get non-economic benefits t , such as technological progress and economic growth and the improvement of people's living standards, such as the region, which have contributed to improving the image of the governments, which to achieve good performance.

Assume 2 Companies decide to ensure the smooth process of cooperation, and actively take active with governments’ supervise, the cost of materials and equipments and capital about universities and institutes are C_2 , but it will benefit from the cooperation process in increments of m , the probability is P_2 . However, if the enterprise for its own sake, rather than reveal some core intelligence resources to the partners, resulting in smooth cooperation can’t continue. then the government departments will corporate fines, penalties of its U , the gains for the R_2 . If the business defaults, Companies need to pay liquidated damages α to the universities and institutes.

Assume 3 In the process of cooperation about industries and universities and institutes, universities and institutes need to provide enterprises with a certain intelligence personnel and intelligence achievements, companies are provided financial and technical supports to universities and institutes. Universities and institutes in the cooperation process secondary research side will gain incremental n , but it will spend time and manpower costs C_3 , the probability is P_3 ; But if universities and institutes in order to maintain some of its core resources to the enterprise rather than in public, it would not be normal cooperation, so government departments will be fine to pay U gains obtained at this time is R_3 . If universities and institutes don’t continue going, universities and institutes need to pay liquidated damages α to the enterprises. If the business and universities and institutes decide to cooperate, then the governments will be encouraged θ .

Assume 4 If the government does not supervised, then when businesses and universities and institutes do not cooperate, the revenue generated is (R_2, R_3) ; If the business and universities and institutes decide to cooperate, then the income is $(R_2 + m, R_3 + n)$.

	Gakken Cooperate(C_1)	Gakken noncooperation (C_2)
Enterprise Government	$R_2+m+\theta-C_2$ $R_3+n+\theta-C_3$ $-C_1-2\theta+R_1+t$	$R_2+\alpha-C_2$ $R_3-\alpha-U$ $-C_1+U$
Regulate(A_1) cooperate(B_1)	$R_2-\alpha-U$ $R_3+\alpha-C_3$ $-C_1+U$	R_2-U R_3-U $-C_1+2U$
Enterprise Government	R_2+m-C_2 R_3+n-C_3 R_1+t	$R_2+\alpha-C_2$ $R_3-\alpha$ 0
Not regulate (A_2) Noncooperation(B_2)	$R_2-\alpha$ $R_3+\alpha-C_3$ 0	R_2 R_3 0

Chart 1: Governments, Enterprise and Universities and Institutes Portfolio and Square Tripartite Game Strategy Payoff Matrix

3.3 Government, Enterprise and Universities and Institutes Equilibrium Analysis about Game Theory

3.3.1 Analysis of Pure Strategy Nash Equilibrium

Through a balanced analysis of the game model shown in Figure 1, you can know eight kinds of pure strategy Nash equilibrium when certain conditions are met, specifically shown in Table 1.

Table 1: Pure Strategy Nash Equilibrium and Conditions

Conditions	Pure strategy combination
$A + m > C_2$ $\alpha + n > C_3$ $C_1 + 2\theta > R_1 + t$	(B_1, C_1, A_2)
$\alpha > C_2$ $C_3 - \alpha > n$ $C_1 > U$	(B_1, C_2, A_2)
$C_2 > m + \theta + \alpha + U$ $U + \alpha > C_3$ $U > C_1$	(B_2, C_1, A_1)
$C_2 - U > \alpha$ $C_3 - U > \alpha$ $2U > C_1$	(B_2, C_2, A_1)
$C_2 > \alpha + m$ $\alpha > C_3$ $C_1 > U$	(B_2, C_1, A_2)
$C_2 > \alpha$ $C_3 > \alpha$ $C_1 > 2U$	(B_2, C_2, A_2)
$\alpha + U - C_2 > 0$ $C_3 > \alpha + U + n + \theta$ $U > C_1$	(B_1, C_2, A_1)
$m + \theta + \alpha + U > C_2$ $\alpha + U + n + \theta > C_3$ $R_1 + t > C_1 + 2\theta$	(B_1, C_1, A_1)

In the pure strategy of Nash equilibrium, in the case of government coordination, it is clearly an ideal state about enterprises and universities and institutes choose to adopt a strategy of cooperation, if they are choosing to operate each other, they will not only receive economic benefits, but also they will get the government's subsidies, while the government will get some direct benefits and indirect interests in the cooperation process. In the case of government incongruous combinations (business cooperation, cooperation in science research side, the government is not regulated) is clearly more reasonable case, which means in the cooperation process about industries and universities and institutes, the governments not only do not pay the cost of coordination and give the amount of subsidies about enterprises and universities and institutes, but also the governments get incomes in the process of cooperation between enterprises and universities and institutes, enterprises and universities and institutes will get their own information technology, they need take advantage of each other's competitive advantages, so promoting the healthy development of their benign. Therefore, regardless of the governments in the implementation of competitive intelligence research whether strategic alliances play a supervisory coordination functions for corporate and academic research, the (cooperation, cooperation) are the optimal choice.

3.3.2 Mixed Strategy Nash Equilibrium Analysis

In the absence of pure strategy Nash equilibrium analysis, government business and academic research side will adopt a mixed strategy, which are used to a certain probability of its pure strategy. Assume that the government adopted the policy A_1 (regulation) in the probability of P_1 , $(1 - P_1)$ is the probability of adoption strategies A_2 (without supervision); enterprise adopted strategy B_1 (cooperation) in the probability of P_2 , $(1 - P_2)$ is the probability of adoption strategy B_2 (non-cooperation); universities and institutes adopted strategy C_1 (cooperation) in the probability of P_3 , $(1 - P_3)$ is the probability of adoption strategies C_2 (non-cooperation), where $0 \leq P_1 \leq 1, 0 \leq P_2 \leq 1, 0 \leq P_3 \leq 1$ expected revenue, the government, business and academic research side choose to take a different strategy is as follows:

The probability of a given business cooperation P_2 , then the government in the process of coordinating and monitoring whether the expected revenue obtained as follows:

$$E_{A1} = P_2 [P_3 \times (-C_1 - 2\theta + R_1 + t) + (1 - P_3) \times (-C_1 + U)] + (1 - P_2) [P_3 \times (-C_1 + U) + (1 - P_3) \times (-C_1 + 2U)] = 2U - C_1 - UP_3 - UP_2 + (R_1 + t)P_2P_3 - 2\theta P_2P_3 \quad (1)$$

$$E_{A2} = P_2 \times [P_3 \times (R_1 + t) + (1 - P_3) \times 0] + (1 - P_2) [P_3 \times 0 + (1 - P_3) \times 0] = (R_1 + t) P_2P_3 \quad (2)$$

$$\text{If } E_{A1} = E_{A2}, \text{ so } P_2 = \frac{2U - C_1 - UP_3}{U + 2\theta P_3}$$

That is, when there is no difference about the expected revenue if the government chooses to supervise or not supervise, you can get the best probability of business cooperation in the game equilibrium is P_2^* . When companies cooperate with probability $P_2 > P_2^*$, then the optimal choice of government is uncoordinated and supervision; Conversely, when companies cooperate with probability $P_2 < P_2^*$, then the best choice is to coordinate and supervise the government; When enterprises is $P_2 = P_2^*$ probability of cooperation, then the best choice is to randomly select government coordination and uncoordinated.

If the universities and institutes choose to cooperate of the probability P_3 , then the expected revenue business cooperation with non-cooperation are:

$$E_{B1} = P_3 [P_1 \times (R_2 + m + \theta - C_2) + (1 - P_1) \times (R_2 + m - C_2)] + (1 - P_3) [P_1 \times (R_2 + \alpha - C_2) + (1 - P_1) \times (R_2 + \alpha - C_2)] = \theta P_1 P_3 + R_2 + \alpha - C_2 - \alpha P_3 + m P_3 \quad (3)$$

$$E_{B2} = P_3 [P_1 \times (R_2 - \alpha - U) + (1 - P_1) \times (R_2 - U)] + (1 - P_3) [P_1 \times (R_2 - U) + (1 - P_1) \times R_2] = R_2 - UP_1 - \alpha P_3 \quad (4)$$

$$\text{If } E_{B1} = E_{B2}, \text{ so } P_3 = \frac{C_2 - \alpha - UP_1}{m + \theta P_1}$$

That is, there is no difference about whether enterprises cooperate ,for universities and institutes, it's the best probability is P_3^* .when the universities and institutes are cooperating of the probability of $P_3 > P_3^*$,so the best strategy is to cooperate for enterprises. If the universities and institutes are cooperating of the probability of $P_3 < P_3^*$,so the best strategy is not to cooperate for enterprises, although enterprises will get compensation for liquidated damages ,but they will also pay certain costs.

If the government decides the probability of P_1 ,so the universities and institutes' expectancy profits are:

$$E_{C1} = P_1 [P_2 \times (R_3 + n + \theta - C_3) + (1 - P_2) \times (R_3 + \alpha - C_3)] + (1 - P_1) [P_2 \times (R_3 + n - C_3) + (1 - P_2) \times (R_3 + \alpha - C_3)] = \theta P_1 P_2 - C_3 P_1 + P_1 P_2 C_3 + n P_2 + R_3 + \alpha - C_3 - \alpha P_2 \quad (5)$$

$$E_{C2} = P_1 [P_2 \times (R_3 - \alpha - U) + (1 - P_2) \times (R_3 - U)] + (1 - P_1) [P_2 \times (R_3 - \alpha) + (1 - P_2) \times R_3] = R_3 - UP_1 - \alpha P_2 \quad (6)$$

$$\text{If } E_{C1} = E_{C2}, \text{ so } P_1 = \frac{C_3 - \alpha - n P_2}{U - C_3 + \theta P_2 + C_3 P_2}$$

That is ,there is no difference about whether the universities and institutes choose cooperate, for the government ,it's the best choice is p_1^* . When the government regulates of the probability of $P_1 > p_1^*$,so for the universities and institutes ,it's the best strategy is cooperate .in return ,in order to achieve much more profits, the universities and institutes should choose cooperate.

4. The Analysis of the Game Results

(1)base on the enterprise: because of $P_2 = \frac{2U - C_1 - UP_3}{U + 2\theta P_3}$,so in the process of government-industry-university-institute strategic alliance of competitive intelligence, Enterprises can go on whether it will have been working in collaboration with Gakken party, the cost amount spent on government coordination, it is a relationship about if we abandon cooperation requiring to pay fines and insist on cooperation will be encouraged. We can find that it is inversely proportional to the amount of P_2 fine with the uncooperative government, the greater the amount of the fine if it shows the government, enterprises in order to avoid paying excessive fines, and more likely to choose to cooperate; probability P_2 venture with Gakken probability proportional to cooperate, it shows that the probability to cooperate if Gakken the larger companies in order to avoid the payment of liquidated damages and penalties, they will tend to choose cooperation strategy.

(2) base on the universities and institutes : because of $P_3 = \frac{C_2 - \alpha - UP_1}{m + \theta P_1}$, Indicates in the process of government-industry-university-institute competitive intelligence strategic alliance , Gakken party learned to cooperate with the probability of government regulation of business if the termination of cooperation, how much penalty to Gakken party to pay, corporate and academic research side when working much of the cost to pay, if Gakken side business and cooperation relations between the government would have to give much encouragement. Therefore, the probability is inversely proportional to P_3 and supervision of government coordination, it shows that if the greater proportion of government coordination regulation, then Gakken party for security reasons, it will reduce the probability of cooperation; probability while Gakken collaboration with co-pay cancellation how many penalty negatively correlated, the more pay liquidated damages, Gakken cooperation probability is smaller. Thus, whether in the above cases, the possibility of business cooperation will be greatly increased, so Gakken parties for their own account, it is a good choice to choose the probability of cooperation.

(3) base on the governments: Unless universities or institutes broke the contract in the process of cooperation, the governments got enough fine, then the government will be from the perspective of rational economic man to choose supervision and coordination, otherwise it will tend to choose not regulated. Taking into account the government's strategic alliance official competitive intelligence research process, it may not be entirely rational economic man from the perspective of strategic choices, and can take the initiative to take some measures to promote the development of tools and the rapid development of the enterprise economy, to accelerate research and innovation capacity and develop competitive intelligence personnel and technology, so there is no longer on the influencing factors of P_1 to do too much analysis.

5. Conclusions and Recommendations

In the process of government-industry-university-institute strategic alliance of competitive intelligence, because of the interests of all parties aren't symmetric. So this paper used game theory to analyze deeply the relationship between governments, business and competitive intelligence Gakken tripartite strategic alliance, constructed entirely information static game model and drew a possible eight kinds of pure strategy Nash equilibrium, launched a pure strategy equilibrium and a mixed strategy Nash equilibrium analysis, discussed the main coalition parties to gain the cooperation and non-cooperation in the selected state, proposed the alliance parties may adopt selection strategy. This paper thought, government-industry-university-institute strategic alliance members on the largest presence on the overall strategy and tactics to maximize the benefits of their own interests, alliances and uncooperative parties may choose to work according to the situation in the league process.

In the short-term and partial course of the game, the presence of coalition parties is in favor of their own optimal strategy, but which would undermine the operation of the entire league. From the long-term interests, coalition parties choose to cooperate would be the best strategy. In order to ensure the smooth progress of the league, to achieve sustainable development in the interests of all parties, the paper proposed to strengthen the following aspects of the work. At first, the government should strengthen propaganda and guidance, effectively established strategic alliances and research models, provided a good policy support and legal environment. Secondly, strengthen exchanges and cooperation in pre-visit, not only to establish a mechanism of mutual trust and cooperation, the main parties have clear responsibilities and tasks, but also to establish the distribution of benefits and punishment mechanisms to effectively prevent and avoid possible existence and occurrence of each kind of risks; Thirdly, pay attention to during the operation to reduce friction and promote the smooth realization of resource.

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