A simulation research on the Impact of Governance Initiated by Broker Agent on Triple Alliance's Performance

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Abstract. The cooperation of alliance needs a powerful agent to coordinate each other's activities. The broker agent who holds the structural holes position usually initiate this kind of governance because of the advantage of information and control. This paper tied to turn the focus from sharing the cake to making a bigger cake: exploring the relationship between governance and performance of triple alliance. Basing on two dimension of external environment complex and exploration capability, we design four situations. Using the simulation experiment we extend the Aggarwal's model and explore how the governance initiated by broker agent affects the triple alliance's performance. The results show that except for the extreme case of high complex and low capability governance will lead to different performance level. The final performance depends on the reasonable matching among complex, capability and governance. At the end we discuss the contribution and the possibility of extension in the future.

1. Introduction

Agent simulation research and computer Games Knowledge Data Engineering provides ample evidence that agents' relative positions in a network correlate with their economic performance [1][2]. Particularly agents linked to others who are disconnected from each other—i.e., those who occupy brokering positions— are promoted faster, generate better ideas, and receive more-favorable evaluations. Although researchers pay more and more attention on how structural hole position on agent's performance [3][4], it has given little attention to how brokering agents coordinate these disconnected partners to achieve alliance performance. Previous studies of structural hole position are mostly concentrated what kind of advantage this special position can bring. In discussing how the broker agents exert information superiority and control advantages, few studies focus on how the broker agents coordinate with Alliance affiliates, and how promote tripartite cooperation, and distribute resource, objective and coordination problems. One of the key factors of triple alliance (the simple alliance with one broker agent) to success lies in how the union coalition parties to govern common activities [5]. Studies have shown that alliances need coordination from someone who had super information processing ability [6]. Because of the advantages of network position, broker agent has more information and thus more right to speak out, which leads to the fact that broker agents usually advocates network governance. In the context of brokerage, agents who exhibit superior coordinating strategy come to achieve seemingly different performance. Therefore, this paper attempts to study how the broker agent take the advantage of structural hole position to coordinate the triple alliance.

2. Model construction

2.1 Problem space.

NK model is particularly suitable for the complex systems construction which is composed of interconnected elements [7][8]. NK model originate from concept of fitness landscape proposed by Professor Wright who used this concept in biology evolution research [9]. The follow-up researcher

Kauffman developed this concept to fitness landscape generation algorithm by constructing a concise design, which is effectively applied in population genetics. This algorithm became the fundamental part in multi-agent model construction and simulation method. NK model is also extended to the study of a wide range of socio-economic systems, such as organizational strategy, organizational design, and team learning [10][11].

In NK model, each decision has N dimensions and every dimension has two values 0 and 1 on behalf of two options. NK model performance is defined the average of all the individual decisions contribution, resulting in different performance landscape. K can be valued in the range between 0 and N, the minimum K takes 0, which represent that there is no correlation between the various decision dimensions, each dimension impact performance independently; when K is valued N-1 every decision dimensions are correlated with each other. The former depicts a simple external environment, which has a flat landscape; the latter simulates a complex external environment, which means a rugged landscape.

The problem space the triple alliance face is designed as followed: Firstly, triple alliance include three agents: A, B and C, agent B hold the structural hole position; secondly, agent A, B and C face the same problem space (N=16 decision dimensions) but each focus on the different part. The details are as followed: agent A and agent B collaborate on space A and B1; agent C and agent B collaborate on space B2 and C. K will control the complexity of the landscape. How to coordinate the partner's behavior to achieve the highest performance is the main work of Agent B, the one who hold the structural hole position.

2.2 Agents search capabilities.

We turn now to the decision-making rules that govern agents' behavior in our simulation. We define an agent as a decision maker having authority over some subset of landscape. We model two dimensions of such capabilities: (1) the ability to make simultaneous decisions over a larger vs. smaller number of the choices controlled, which we term the 'search radius' as per prior literature [12]; and (2) the ability to evaluate a larger vs. smaller number of alternatives in a given period [13]. For the search radius (parameter SR), we model a simple case where SR=2, as well as a more complex case where SR=4; for the number of alternatives (parameter ALT), we also model a simple case where ALT=4 and a complex case where ALT=14.

2.3 Governance modes

As prior research mentioned, there are four dimensions should take into our consideration when we model the alliance governance modes: (1) number of decision makers (agents), (2) order of decision making, (3) metrics used to evaluate the implications of choices, and (4) nature of oversight and hierarchy around the decision-making process. Furthermore, we model four governance modes the agent B can take.

Table 1 Four Governance Modes

Governance mode	Search arrange	Strategy of broker agent
Modular (MOD)	A,C, B1 and B2	Sub-project optimal
Corporation (COP)	A,C and B1+B2	Agent optimal
Department (DEP)	A+B1 and B2+C	Sub-alliance optimal
Integrated (INT)	A+B1+B2+C	Whole-allince optimal

3. Simulation experiment design

We will first generate the corresponding performance landscape based on the determined value of N and K values. In the case of N = 16 configuration decisions facing feasibility Space Alliance network will contain a total of 65,536 decisions to select. By K values to control the external environment Network complexity, SR corresponding ALT control Alliance exploration capabilities. Specific variables described in Table 2 below. Each simulation experiment is set to 300 time steps, after repeated experiments estimated 300 time steps after the system has reached equilibrium, Alliance Performance Management Mode four have reached their highest point. Each experiment will be repeated 1000 times and the results averaged to eliminate the influence of random errors.

4. Results and Analysis

According to the external environment and agent exploration ability, we discuss the triple alliance performance under these four cases. Firstly, we model the condition under which K=12； SR=2； ALT=4, which means alliance is facing a complex environment while agent's exploration ability is weak. Figure 4 illustrates the performance of the four governance modes on this pattern. The curves almost overlap with each other, which means that none of four governance mode can achieve a higher performance due to the complex environment and poor ability, all agents fall into the local optimal points.

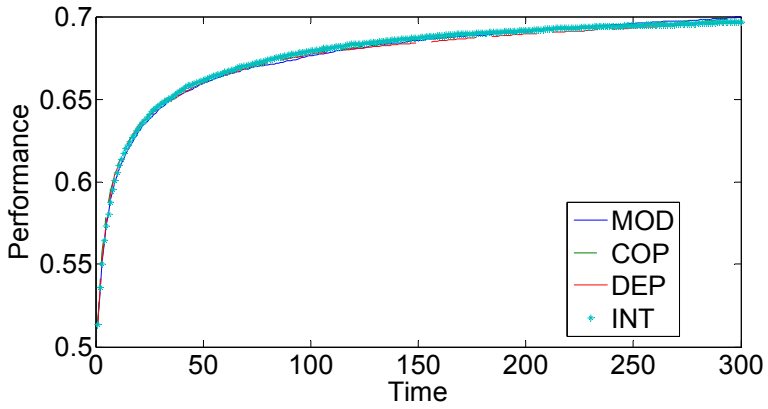

Fig 4 Relationship between governance and performance (complex environment and poor ability)

Turning next to Figure 5, we examine the performance of the different governance modes under the conditions where K=12； SR=4； ALT=14, which means the environment is complex but agent exploration ability is strong. The results show that INT goes first, COP goes second, and DEP and MOD almost go in the same traject. The most coordinate governance mode surpass the other modes when alliance facing the complex enevronment and possessing the strong ability.

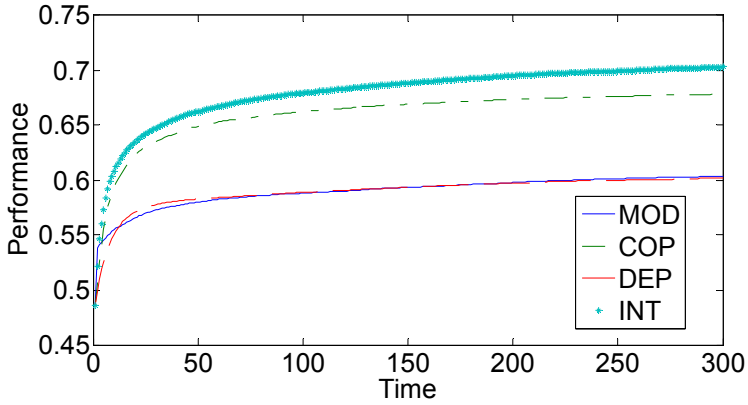

Fig 5 Relationship between governance and performance (complex environment and strong ability)

Conclusion and discussion

In this paper, we have sought to better understand how modes of governance affect the performance of agents in alliance relationships. According to the environment and agent exploring ability we divide governace mode into four pattern. Simulation results show that: when the external environment is complex, if agent's exploring ability is weak alliance will achieve the same performance level under all four governace modes, while in the case agents have a strong exploring ability alliance's final performance depends on the exploring rang. When the external environment is simple and agent's ability is weak, under some situation where there is trade-off picture showing up, if agents have strong ability there is an inverse U relationship between governance mode and alliance performance.

Results of this study showed that apart from extreme circumstances (environment complexity & Exploration weak), governance models have an important impact on the performance of Alliance. But among these four governace modes no one can exhibit unique optimal performance level all the time.

This suggests that the ultimate level of performance of tripartite alliance depends on its external environment, explore their own ability to match the structure of corporate governance. When the external environment is complex and agents have a strong exploration ability, agent holding the structural holes position should take governance model to coordinate the alliance partners as much as possible to expand the search rang to avoid falling into local optimum. In this situtation structural holes agent should take the "coordinated promote" behavior strategies to achieve the most benefit for the entire alliances. This study contributes to the broader conversation around the performance consequences of agents relationships.

This study has a few limitations. Firstly we only consider the undirected relation among the agents. In the future research we should consider the directed relation which means the competition and confrontation [14]; secondly, we choose the default assumption that broker agent would master the power to coordinate the alliance partners. But in some cases there are many factors affecting the power structure like reputation besides the information. As a fundamental simulation model there is absolutely space to expand in the future research. The author encourages others to apply a multi-agents lens to studies of alliance performance in comparative fields in order to broaden the complexity and simulation research.

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