Game Theory in Business Collaboration

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Abstract

This paper examines how game theory is being creatively applied to business collaborations between organizations, with specific reference to the negotiation of access control policy. It is proposed that when game theory is applied, it improves decisions regarding improving company performance.

Game Theory has been examined in several disciplines, such as Mathematics and Economics. Strategically, this has been used to improve quality and maximize profits, including the structure and the analysis of the actual strategies used. From here it is suggested that the use of game theory to find the best strategy could prove to be highly beneficial. Despite this realisation, there is little research on the applications of game theory in business environments.

Business collaboration is characterized by long-time execution, heterogeneous and autonomous business communications among multiple business participants with asynchronous business interaction, transactional semantics and policy coordination.

This project firstly analyses the business collaboration, followed by the analysis of the characteristics of game theory. From this analysis, it is proposed that the business collaboration problems can be aligned with game theory solutions in order for better and effective outcomes.

The overall outcome of this project is to demonstrate how game theory can play a major role in finding and implementing better decisions in regards to the negotiation of access control policies.

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1. Introduction

Nowadays, a simple business process involves multiple business partners – customers, dealers, sales representative and logistic company. On the other hand, businesses are increasingly outsourcing key operations and interacting with ever extending nets of partners. Since different players' decisions can have an effect on selecting the optimal solution, the solution selecting process becomes complicated.

Collaborative computing requires a variety of information-access agreements ranging from those business to business sharing of application objects and services to those for joint administration of access policies among autonomous domains of the Internet.

An important characteristic of such agreements is the negotiation of access to a set of information reflecting the sharing preferences of the parties involved. Such negotiations typically seek agreement on a set of access properties, which represents the *common interpretation of a policy model*, and then on a *common state*, which reflects the shared accesses to resources of the parties involved and satisfies the negotiated access properties. We say that such an agreement is the result of the negotiation of access control policies.

A Business Collaboration is a set of roles interacting through a set of choreographed Business Processes. Due to lack of trust, policy of access is required for ensure security between organisations. The access control policy of a single organisation or service is defined in terms of roles and their privileges. Given a request to access a resource or perform an operation, the service enforces the policy by analysing the credentials of the requester and deciding if the requester is authorised to perform the actions in the request business to business integration is basically about the secured coordination of information among businesses and their information systems. It promises to dramatically transform the way business is conducted among organisations. Negotiation of common access to a set of resources reflects the sharing preferences of the parties involved. Such negotiations typically seek agreement on a set of access properties.

A common interpretation of the policy model adopted by collaborating parties is essential for reaching resource access agreements, particularly when joint administration of shared resources is being sought. (see figure 1) The common interpretation of the policy model consists of the specific properties of access authorization, management, and attribute-definition components of the policy model implemented by the collaborating parties. For example, the access management area may include the property that selective and transitive distribution of privileges requires selective and transitive revocation of privileges; or that the distribution and revocation of privileges be owner-based. Such properties must be supported by all collaborating parties for joint administration of shared resources and hence must be negotiated.

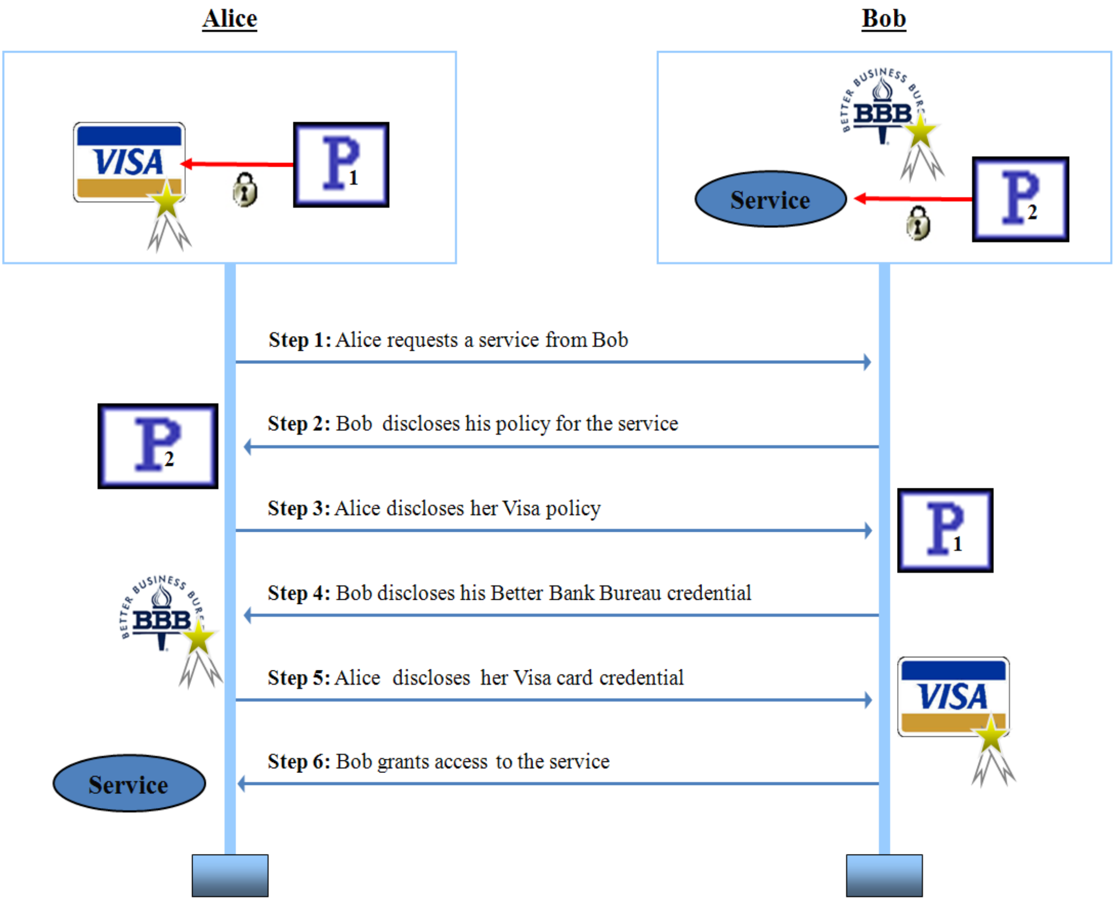

Figure 1 example of an access policy model

Game Theory has been an important theory in several areas such as Mathematics, Economics and Philosophy because Game theoretic concepts apply whenever the actions of any individuals, groups, firms are interdependent. Also, it helps them to choose a better strategy to maximise their payoffs in terms of quality or profit.

Quality and profit defined in access control means increasing the security level such that increases trust between organisations. Enhance, it enforces the cross-organisation collaboration.

In terms of business collaboration, we could apply game theory to model the business collaboration situation such that we can find out a better strategy for decision making.

Therefore, the aim of this project is to investigate how Game Theory can be applied to Business Collaboration aspect for decision making in terms of maximising profit or improving performance. We will take negotiation of access control for our situation and find out a game model. Therefore, we can continue this project based on the model and then formulate a strategy to improve length of the negotiation of access control.

In this workshop paper it is constructed as followings: in Section 2 and 3 are some related research about game theory and business collaboration; Section 4 discusses the methodology how we solved the problem; Section 5 presents the analysis outcomes of the research. Finally, Section 6 concludes the paper and recommends the future work for this project.

2. Business Collaboration

A Business Collaboration is a set of roles interacting through a set of choreographed Business Transactions by exchanging Business Documents. A Business Collaboration is defined by the parties in the collaboration; it can be simple or complex, it can include expected and unexpected actions and the collaboration can allow for other than e-Business options. It is about the capability to transition to human interactions or decisions that may be important to e-Business activity, e.g. a phone call.

A business activity consists of regular collaborative work among participants to achieve a business objective. An activity structure is a digital schema-based representation that describes the properties of a business activity and that semantically relates it to the people, artifacts, tools, and events involved in carrying out the business activity. There are also relationships between interacting activity structures.

2.1 Business Collaboration Overview

The first dimension is collaboration aspects which place emphasis on the different behaviors of an enterprise in business collaboration**:**

- Before seeking partners to cooperate with an enterprise will first need to capture its private behavior in the internal business process aspect. (Swaminathan and Tayur, 2002)
- Based on its internal behavior the enterprise can then specify its capabilities in its externally visible behavior in the participant public behavior aspect. (Decker, 2006)
- Enterprise negotiates with other parties to establish cooperation. (Orriens *et al*, 2006; Orriens, 2006)

2.2 Business Collaboration Characteristics

The business collaboration characteristics are:

- Long-time execution.
- Heterogeneous and autonomous business process communication among multiple business participants. (Axelsson *et al*, 2002)
- cross-organisational asynchronous business interaction. (Joines *et al*, 2001)
- Complex business-oriented transactional semantics.
- Cross-organisational transaction policy coordination.

Also, it has to be consistency which is the core requirement of collaboration. Consistency also needs support from other business transaction requirements, such as atomicity, isolation and time constraint to guarantee the consistency in individual organization as well as the whole business collaboration. (Sun, 2007)

2.3 Challenges in Business Collaboration

Trust is one of the major challenges in business collaboration. Many studies have shown that the impediment to online payment is the lack of trust in E-business. (Yang *et al*, 2006)

Current standards in business collaboration design, due to their pre-defined and inflexible nature, are precluded from accommodating business dynamics. The challenge is thus to provide a solution in which business collaboration development can be done in a flexible and adaptive manner. (Fensel, 2001)

Buyers will need to maintain established long-term relationships with preferred suppliers. Therefore, a variety of business models are likely to continue to be viable in the marketplace. (Sun, 2007)

The types of models where the principal faces hidden action are known as moral hazard models. Consider a small firm selling specialized medical equipment via a sales force, which currently consists of a single salesman. The salesman (agent) represents the firm owner (principal) to the clients. The total amount of sales, and hence, the firm's revenues, depend on the efforts of the salesman. If the salesman does not work hard, the sales volumes from the new contracts are low, or potential customers are lost to competitors. Thus, the firm owner would like to design a contract and offer it to the salesman with the goal of providing an incentive to the salesman to work hard, such that both parties will mutually benefit. This situation is an example of the principal-agent problem. (Axelsson *et al,* 2002)

All of the papers contain a clear discussion about the business collaboration behavior, characteristics and challenges. However, there is no relevant work solving the problem with game theory.

2.4 Access Control

Although Web Service technologies provide techno- logical support for dynamic, cross-organization collaboration, security concerns can be a barrier to the adoption of this new technology. Service collaboration through service compositions or other means could have different access control requirements to the individual's services in the collaboration; how to provide end-to-end security guarantees is still an unsolved problem.(He *et al*, 2009)

Looking at the overview, the important part is that we understand enterprise has to negotiate with other enterprises for cooperation. It is because one of the business collaboration characteristics is cross organisation policy coordination. It is indirectly indicated that access control taken place between business collaboration. Moreover, trust is one of the most important challenges for business collaboration. With access control, we can see the level of trust increases. We can tell because of some other researches like Yu, Winslett and Seamons (2003) talked about Tradeoff between the length of the negotiation, the amount of information disclosed, and the computation effort. However, they did not apply Game Theory into their research to solve the problem. Not only,

3. Game Theory

Game theory analyzes strategic interactions in which the outcome of one's choices depends upon the choices of others. For a situation to be considered a game, there must be at least two rational players who take into account one another's actions when formulating their own strategies.

If one does not consider the actions of other players, then the problem becomes one of standard decision analysis, and one is likely to arrive at a strategy that is not optimal. For example, a company that reduces prices to increase sales and therefore increase profit may lose money if other players respond with price cuts. As another example, consider a risk averse company that makes its decisions by maximizing its minimum payoff (maxmin strategy) without considering the reactions of its opponents. In such a case, the minimum payoff might be one that would not have occurred anyway because the opponent might never find it optimal to implement a strategy that would make it come about. In many situations, it is crucial to consider the moves of one's opponent(s).

Game theory assumes that one has opponents who are adjusting their strategies according to what they believe everybody else is doing. The exact level of sophistication of the opponents should be part of one's strategy. If the opponent makes his/her decisions randomly, then one's strategy might be very different than it would be if the opponent is considering other's moves. To analyze such a game, one puts oneself in the other player's shoes, recognizing that the opponent, being clever, is doing the same. When this consideration of the other player's moves continues indefinitely, the result is an infinite regress. Game theory provides the tools to analyze such problems.

Game theory can be used to analyze a wide range of strategic interaction environments including oligopolies, sports, and politics. Many product failures can be attributed to the failure to consider adequately the responses of competitors. Game theory forces one to consider the range of a rival's responses.

3.1 Game Theory Characteristics

The Algorithm Game Theory talks about the usefulness of game theory. (Nisan *et al,* 2007) This is the foundation reading for the project because it covers most of the Game Theory terminologies.

It identifies some main terms:

Player: Any participant in a game who has a nontrivial set of strategies and selects among the strategies based on payoffs.

Payoffs: In any game, payoffs are numbers which represent the motivations of players. In all cases, the payoffs must reflect the motivations of the particular player.

Strategy: A strategy defines a set of moves or actions a player will follow in a given game. A strategy must be complete, defining an action in every contingency, including those that may not be attainable in equilibrium. For example, a strategy for the game of checkers would define a player's move at every possible position attainable during a game. Such moves may be random, in the case of mixed strategies. (Webb, 2007)

Game: A situation in which a conflict arises between two or more players.

Nash Equilibrium: Nash equilibrium is a set of strategies which represents mutual best responses to the other strategies. In other words, if every player is playing their part of Nash equilibrium, no player has an incentive to unilaterally change his or her strategy. Considering only situations where players play a single strategy without randomizing a game can have any number of Nash equilibria. (Stengel, 2008)

Complete Information: game is one of complete information if all factors of the game are common knowledge. Specifically, each player is aware of all other players, the timing of the game, and the set of strategies and payoffs for each player.

Sequential: A sequential game is one in which players make decisions following a certain predefined order, and in which at least some players can observe the moves of players who preceded them. If no players observe the moves of previous players, then the game is simultaneous.

Zero Sum: All outcomes involve a sum of all player's payoffs of 0.

Cooperative: A cooperative game is one in which players are able to make enforceable contracts. Hence, it is not defined as games in which players actually do cooperate, but as games in which any cooperation is enforceable by an outside party.

Repeated: When players interact by playing a similar stage game numerous times, the game is called a repeated game.

Coordination Game: It is a class of games with multiple pure strategy Nash equilibria in which players choose the same or corresponding strategies.

Also, Game theory is believed to give an optimal decision in order to gain maximum profit in terms of business. Perng (Perng *et al*, 2007) made an argument that Game Theory reveals an attractive profit increase for formwork subcontractors joining a coalition.

3.2 Game Theory Models and Framework

In Andrea's research, (Schalk, 2003) it stated that Game theory assumes that a player evaluates various outcomes in terms of the utility derived from them. There are two key points in a co-operative game:

- What is the payoff for each coalition?
- What payoff each player in the coalition should get?

The benefits acquired by the different members of the various coalitions are different. Consistent with the definition of co-operative games, if the profit gained by a co-operating player exceeds that which would be gained when acting independently, that player will certainly seek to establish a coalition. The method adopted for allocating benefits and costs among the members will affect the willingness of various members to remain active in the coalition. The allocation problem may be solved in a variety of ways, but an allocation rule that prescribes, somehow, a solution for the allocation problem should satisfy desirable criteria such as efficiency, fairness and others. (Schalk, 2003)

On the other hand, Mahesh Nagarajan and Greys Sosic also made a strong argument about applications of cooperative game theory to supply chain management. Special emphasis is placed on two important aspects of cooperative games: profit allocation and stability. (Nagarajan and Sosic, 2006)

When evaluating a situation in which game theory is applicable, the following framework is useful.

1. Define the problem.
2. Identify the critical factors. Examples of critical factors include differentiated products, first-mover advantage, entry and exit costs, variable costs, etc.
3. Build a model, such as a bimatrix game or an extensive form game.
4. Develop intuition by using the model.
5. Formulate a strategy - cover all possible scenarios.

A good strategy could be used as a set of instructions for someone who knows nothing about the problem. It specifies the best action for each possible observation. The best strategy may be formulated by first evaluating the complete set of strategies. The complete set of strategies is a list of all possible actions for each possible observation.

3.2.1 Bi-matrix Games

In a bi-matrix game, there are two players who effectively make their moves simultaneously without knowing the other player's action. A bi-matrix game can be represented by a matrix of rows and columns. Each cell in the matrix has a pair of numbers representing the payoff for the row player (the first number) and the column player (the second number). The game has the following form in figure 2:

Row Player (RP)	***Column Player (CP)***	
	CP Option 1	**CP Option 2**
RP Option 1	(Payout to RP, Payout to CP)	(Payout to RP, Payout to CP)
RP Option 2	(Payout to RP, Payout to CP)	(Payout to RP, Payout to CP)

Figure 2 structure of bi-matrix game

The general form of equilibrium in a bi-matrix game is called a *Nash Equilibrium*. If both rivals have dominant strategies that coincide, then the equilibrium is called a *dominant strategy equilibrium*, a special case of a Nash equilibrium.

A dominant strategy, if it exists, is for one of the players the strategy that is always the best strategy regardless of what one's rival plays. A dominated strategy is one that is always the worst regardless of what one's rival plays. In games having more than two rows or problems, one may find it useful to identify one option that is always better or worse than another option, in other words, that dominates or is dominated by another option. In this case, the inferior strategy can be eliminated and the game simplified such that more options can be eliminated based on the smaller matrix.

If no options dominate any others, a Nash equilibrium might still be found by evaluating each player's best option for each option of the opponent. If a cell coincides for both players, then that cell is a Nash equilibrium. A game can have more than one Nash equilibrium, but one of them may be the more likely outcome if it is better for both players.

3.2.2 Extensive Form Games

Extensive form games are modeled with dots with arrows that point to other dots. A node is a decision point. The beginning point is depicted by an open dot, which usually represents a state from which a situation will arise by chance. Decision points are labeled with the name of the player making the decision. In figure 3, it shows the structure of an extensive-form game representation.

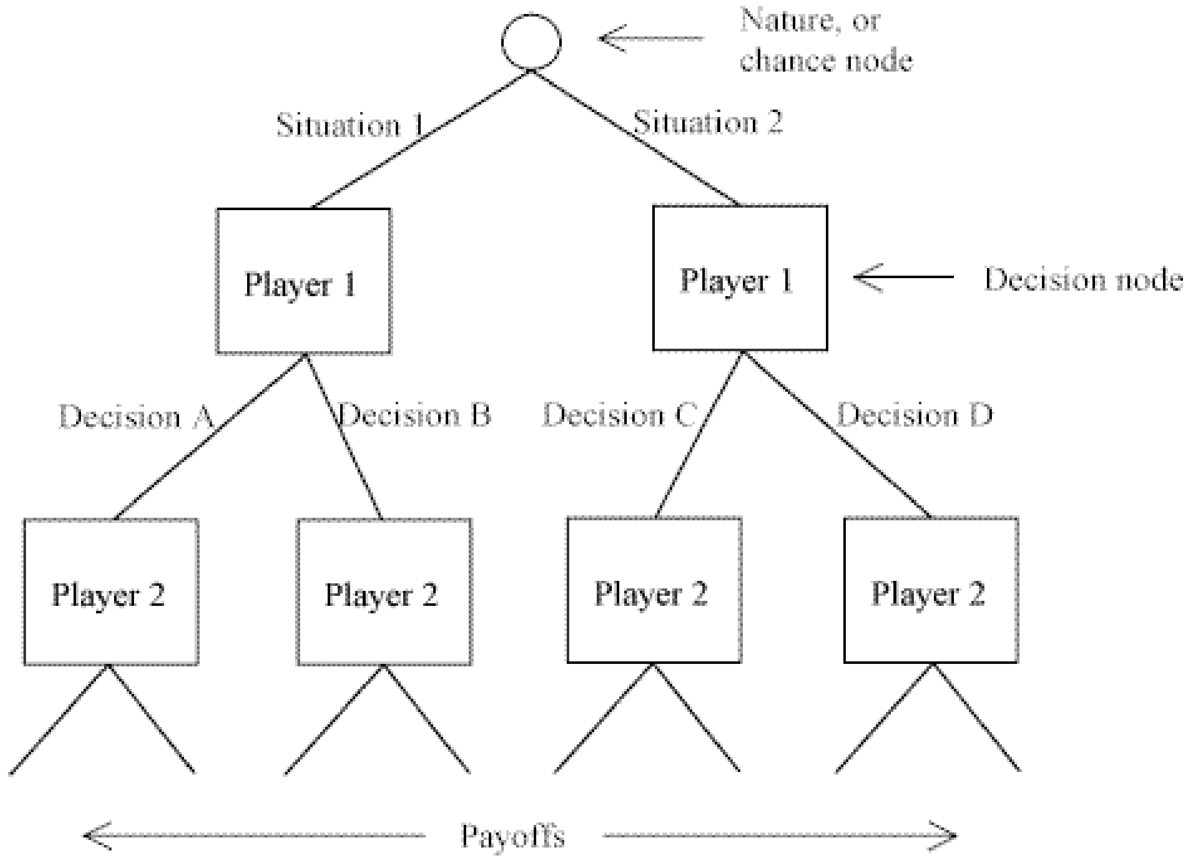

figure 3 Structure of an Extensive Form Game

Chance nodes can appear anywhere in the extensive form tree.

An information set is a collection of nodes that are controlled by the same player, but which are indistinguishable for that player. In other words, for nodes in the same information set, the player does not know which one he/she is at, but does know that these nodes are different. In the preceding diagram, the drawn information sets might arise if Decision A and Decision C were indistinguishable to Player 2, as well as Decision B and Decision D. If a single dotted line encompassed all the Player 2 decision nodes (or 4 dotted circles all connected), then Player 2 would not be able to distinguish between any of the four decisions.

An extensive form game without information sets designated is one in which the players know exactly where they are in the tree. This situation is equivalent to one of dotted circles drawn around each decision point in the tree but not connected to one another. If neither player can observe anything about the other player's action, the sequential extensive form game can be reduced to the simultaneous-action bimatrix game.

3.2.3 Normal-Form (Strategic Form) Game Representation

The extensive form of representing a game can become difficult to manage as the game gets larger, and the Nash equilibria may become difficult to find. The extensive form representation can be collapsed into the normal form, which encodes the game into a strategy that describes the action to take for each conceivable situation (for example, for each information set). The normal form is a complete listing of all the possible strategies along with their payoffs. For a generic case in which there are three situations (information sets) based on Player 1's move, and two possible responses by Player 2, the normal form takes the following structure:

		Player 1					
		If Player 1 does A, then	If Player 1 does B, then	If Player 1 does C, then	A	B	C
Player 2	1)	d	d	d	(__,__)	(__,__)	(__,__)
	2)	d	d	e	(__,__)	(__,__)	(__,__)
	3)	d	e	d	(__,__)	(__,__)	(__,__)
	4)	d	e	e	(__,__)	(__,__)	(__,__)
	5)	e	d	d	(__,__)	(__,__)	(__,__)
	6)	e	d	e	(__,__)	(__,__)	(__,__)
	7)	e	e	d	(__,__)	(__,__)	(__,__)
	8)	e	e	e	(__,__)	(__,__)	(__,__)
					Payoffs		

Figure 4 Normal Form structure

3.3 Game Theory in Business Application

Hu, Yu and Huang have discussed the applications of both Nash equilibrium of dynamic game and bargaining game theory to Collaboration Planning Model respectively. The possibility and feasibility of attaining the goal of win-win and the conditions required are discussed for the cooperative enterprises of upstream and downstream in Supply Chain Management. The simulation results verified the effectiveness of the model and algorithm. (Zhu *et al*, 2005) Moreover, the collaboration planning model is established by negotiation instead of automated negotiation.

Again, Mahesh Nagarajan, Greys Sosic also did a research with Supply Chain. They described the construction of the set of feasible outcomes in commonly seen supply chain models, and then used cooperative bargaining models to find allocations of the profit pie between supply chain partners. A few models including negotiation model were analyzed and surveyed, and included suppliers selling to competing retailers, and assemblers negotiating with component manufacturers selling complementary components. Then they discussed the issue of coalition formation among supply chain partners. (Nagarajan and Sosic, 2006) However, they did not consider a repeated game which extended their model to an arbitrary number of players and a repeated game.

Ken Binmori and Nir Vulkan (1997) pointed out that:

- For some protocols, the system itself can choose equilibrium in an unproblematic manner.

- When the choice of an equilibrium selection norm would itself give rise to bargaining problems among the players, the equilibrium refinement theories of game theory can be given new life. Therefore, they have a non controversial means of interpreting the counterfactuals involved when observing that optimizing players stay on the equilibrium path in a game.

Where analytic approaches fail, algorithmic methods for computing fix points corresponding to equilibria can be realistically employed. From propose the incompletely cooperative game that can improve the system performance of Wireless Mesh Networks framework. In this game, firstly, each player estimates the game state, i.e., the number of competing nodes. Secondly, based on the estimated game state, each player tunes its equilibrium strategy by changing its local contention parameters. Finally, the game is repeated finitely to get the optimal performance. Our results show that the incompletely cooperative game is an appropriate tool to improve the performance of Wireless Mesh Networks.

3.4 Coordination Game

Coordination games with strategic complementarities typically have multiple equilibria. Multiplicity of equilibria is associated with strategic uncertainty to which we cannot assign probabilities by pure deductive reasoning. Strategic uncertainty has often been described as a situation of Knightian (endogenous) uncertainty as opposed to risky situations that are characterized by given probabilities. In this paper we present an experiment designed to measure individual attitudes towards strategic uncertainty and compare them with risk aversion and other personal characteristics.

They consider a simultaneous incomplete information coordination game where each agent has little knowledge about the type distribution, and show the existence of a unique equilibrium with a little assumptions on the strategies of agents. Even in the standard Bayesian coordination game where type distribution is common knowledge, a unique equilibrium is difficult to obtain.

We are interested in the following coordination game: N players simultaneously decide whether to contribute an amount Z to a public good or to an investment that is installed if the total revenue is at least Z K, where $1 < K \leq N$. Contribution yields a return greater than Z, if and only if at least K players contribute. Games of this structure are also used to model network goods, currency and liquidity crises, and bubbles. Players' choices are strategic complements, and the game has two equilibria in pure strategies for any nonnegative Z below the value of the public good. If everybody else contributes, the best response is to contribute as well and receive the high payoff. If nobody else decides to invest, then it is a best response to stay out and save the costs.

The payoff matrices for three simple coordination games, G-I, G-II and G-III, are described in Tables 1-3. Each is a two-player game where players simultaneously choose between two actions, labeled "SAFE" and "RISKY". In each game there are three Nash equilibria: (SAFE, SAFE), (RISKY, RISKY), and a mixed-strategy equilibrium. In G-I, a player can get a sure payoff of 0.8 by choosing SAFE, or can participate in a lottery which pays off either 0 or 1 by choosing RISKY. The lottery pays 0 if the opponent plays SAFE, and pays 1 if the opponent plays RISKY. A risk-neutral player should choose RISKY if the subjective probability they assign to their opponent playing RISKY is greater than 0.8. This subjective probability of RISKY that leaves a player indifferent between the two actions will be denoted p*. G-II and G-III have slightly different payoffs but are similar in structure to G-I. In G-II p* = 0.875, and in G-HI p* = 0.75. This means (SAFE, SAFE) is a risk-dominant Nash equilibrium in all three games.

	SAFE	RISKY
SAFE	0.8, 0.8	0.8, 0
RISKY	0, 0.8	1, 1

Payoff matrix for Game G-I

	SAFE	RISKY
SAFE	0.7, 0.7	0.9, 0
RISKY	0, 0.9	1, 1

Payoff matrix for Game G-II

	SAFE	RISKY
SAFE	0.9, 0.9	0.7, 0
RISKY	0, 0.7	1, 1

Payoff matrix for Game G-III

It is assumed that player i uses a Beta distribution with parameters ai and *fli* as an initial prior for the probability that his or her opponent plays RISKY. 6 The expected payoff from choosing RISKY for a player with these beliefs is *Pil,* where

$$p_{i1} = \frac{\alpha_i}{\alpha_i + \beta_i}$$

is the expected value of the Beta distribution. The expected payoff from choosing SAFE is *qil = Pil 7rd -+-* (1 - *Pil)~ e,* where 7r d is the payoff to a player who chooses SAFE when his or her opponent chooses RISKY (e.g. 0.9 in G-II) and ~r ¢ is the payoff to a player who chooses SAFE when his or her opponent chooses SAFE (e.g. 0.7 in G-II). Thus, if beliefs are heterogeneous, we may expect the initial behavior of expected payoff-maximizing subjects to vary: *pil* may exceed *qil* for some subjects and not for others.

4. Methodology

Before the analysis, we have made some assumptions:

- Each decision maker ("PLAYER“) has available to him two or more well-specified choices or sequences of choices.
- Every possible combination of plays available to the players leads to a well-defined end-state that terminates the game.
- A specified payoff for each player is associated with each end-state.
- Each decision maker does not have perfect knowledge of the game and of his opposition; that is, he does not know in full detail the rules of the game as well as the payoffs of all other players.
- All decision makers are rational; that is, each player, given two alternatives, will select the one that yields him the greater payoff.

First, we used the characteristics from section 2.1 to analyse the negotiation of access control policy situation.

We have 7 classification criteria.

- Players: How many players will be in this negotiation policy game? The answer could be zero, two or more than two.
- Strategy: In a game each player chooses from a set of possible actions, known as strategies. In this situation would be accepting the policy or denying the policy.
- Nash Equilibrium: It has a mutual best response to the other strategies.
- Sequential: One player performs her/his actions after another is a sequential game.
- Complete information: If it is a sequential game and every player knows the strategies chosen by the players who preceded them.
- Zero Sum: One gain is the loss of the others.
- Repeated: players play the game numerous times.

After we went through all these questions, we found out the game type of business collaboration challenge.

Then, we compare to the analysis for the games of Game Theory. (See Table 1) These results assisted the future work to create formula for selecting strategy.

Game	Players	Strategies per player	Sequential	Complete information	Zero sum
Cake cutting	infinite	infinite	No	Yes	Yes
Coordination game	*N*	variable	No	No	No
Diner's di-lemma	*N*	2	No	No	No
El Farol bar	*N*	2	No	No	No
Guess 2/3 of the average	*N*	infinite	No	No	Yes
Minority Game	*N*	2	No	No	No
Peace war game	*N*	variable	Yes	No	No
Pirate game	*N*	infinite	Yes	Yes	Yes
Screening game	*N*	variable	Yes	No	No
Signaling game	*N*	variable	Yes	No	No

Table 1. Game Model Analysis

5. Result

After the analysis, we have the result that negotiation of access control policy is a non-cooperative, n-person game with incomplete information.

First of all, it could be many different organisations request for the access of the specific service. Therefore, it is a 2 person game which can have many requester to play this negotiation game at the same time. Then, in our assumption, we said they do not have full knowledge about the game which is incomplete information. Since all requests are sent as individual, it is a non-cooperative game. We found that the once the negotiation is done, they may negotiation again in the future such that it is a sequential game.

Bob	***Alice***	
	Enough Credential	**Not enough Credential**
Reject	(Negative, Negative)	(Positive, Negative)
Accept	(Positive, Positive)	(Negative, Positive)

Figure 5 model for negotiation of access control

Next, we compared it with our game model analysis. It turns out there are a close match with coordination game.

6. Conclusion and Future Work

Game theory helps us model, analyse, and understand the behaviour of multiple self-interested agents who interact while making their decisions.

Most business situations can be modeled by a “game,” since in any business interaction involving two or more participants the payoffs of each participant depend on the other participants’ actions.

This paper has given an overview of game theory and business collaboration.

Also, it analysed some game models in game theory and lastly we defined the access control policy is classified as a non-cooperative, n-person game with incomplete information and it has the same characteristics as coordination game.

This paper intend to develop a strategy from Game Theory to solve the business collaboration challenge such that it could bring a significant improvement. The future work would be investigating the strategy for coordination game and then model it in a mathematical fashion such that we can use formula to conduct experiment.

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