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Game Theory – A Systematic Literature Review

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Abstract

The mathematical analysis of situations with conflicts of interest is called game theory. (G.Owen, 2012) (Roy et al., n.d.). Additionally, it may be used to create rules such that regular game play results in a just conclusion (for example, assigning voting weights in a parliament where members represent constituencies of various sizes). It is a formal theory that assumes perfect reason, but it may also—and frequently—be utilised as a toolbox of idea techniques for research that assumes thin rationality. This category of applications in housing studies is presented and discussed in relation to four different societal levels: gender and generational relations in the household, problems with collective action in housing estates, local governance networks in urban renewal, and nested games over national housing regimes. A larger use of lightly rationalistic game models should be very beneficial for research into urban government, national housing regimes, and housing sustainability. Games can be classified as having complete or imperfect knowledge, as cooperative or noncooperative, as zero-sum or non-zero-sum games, and so on. The emphasis in noncooperative games is on finding tactics that are in equilibrium or that are, in some ways, beneficial.(McEachern, 2017) In cooperative games, the focus is placed on the negotiation and coalition-building process. The issue of learning is equally significant in games with missing information. Game theory often presupposes that the players are fully informed about the game they are playing, i.e., they are aware of the tactics that are accessible, the probabilities associated with random actions, and the reward functions. In reality, this isn't always the case. Theorists have so investigated scenarios in which players' subjective probability for the games they are playing are present. Aumann and Maschler have investigated the conundrum posed by a player who wants to use secret knowledge but worries that doing so would give it away to an adversary, as well as the conundrum faced by a player who wants to infer information from an adversary's movements.(*GAME THEORY-NASH EQUILIBRIUM AND ITS APPLICATIONS*, 2015a) Therefore, game theory cannot suggest an ideal course of action for a specific player without simultaneously supplying a means for that player to predict the choices of other players. To put it another way, game theory is concerned with defining the actions for all players, guaranteeing that each player's selected actions are optimum given the actions of other players, meaning that optimality is relative. As a result, it is frequently challenging to determine the optimum result from all participants' perspectives. Therefore, game theory's utility resides on its capacity to simulate player interaction. Such a model can rule out some

options that could not otherwise be considered, as well as explain findings involving multiperson decision-making settings. (Burguillo, 2018)

Keywords

Game Theory, Nash Equilibrium, Demand response, Competition, Conflict management, Prisoner's dilemma

Introduction

The human mind has been engaging in games ever since the inception of the species. The law of the jungle has governed our actions for the greater part of our existence on this planet, which clearly highlights the existence of a subconscious mind which helps us differentiate between what is 'right' and 'wrong'. Much before the theory of games played was formalized; we fought wars, assigned armies, and engaged in negotiations that compelled us to study and know about the human mind to an altogether different level (theory of games of strategy). From Darwin's theory of evolution to advanced studies done by Sigmund Freud, from Socrates's arguments in the symposiums of ethics to Shakespeare's Henry V.- The study of game theory has always been an important aspect while making investigations about the human mind and its behaviour.

The modern-day definition of game theory can be put something like this- Game theory is the study of the ways in which interacting choices of economic agents produce outcomes with respect to the preferences (or utilities) of those agents, where the outcomes in question might have been intended by none of the agents. (www.coursehero.com/file/119362850/Team-4-Game-Theorypptm/) It is the study of how to mathematically determine the best strategy for given conditions in order to optimize the outcome. It is the theory of how optimal strategies are formulated in times of conflict (ross, 1997) (BOWMAN &Gould). (www.coursehero.com/file/119362850/Team-4-Game-Theorypptm/, n.d.)

One of the best real-life possible examples of applying game theory is 'Prisoner's Dilemma'. The prisoner's dilemma is one the aptest applications of game theory and was first framed by Merrill Flood and Melvin Dresher while working at RAND in 1950. Later it was formalised by a Canadian mathematician Albert. W. Tucker in 1993 (BOWMAN & gould)It basically proves how two sane and rational humans would not cooperate and do the right thing even if it is in their best interest. The optimum reward for both parties would be if they agree to cooperate.

For example:- If a police officer has arrested 2 criminals for a crime. Both of these criminals are kept in two different cells and can't have any contact with each other. The police offer both the criminals to either remain silent or blame the other. If both of them remain silent, they will get one year of prison time (Von Neumann and the Development of Game Theory). If both of them turn on each other, both will get 3 years of prison time each. And if only one of the accused blames the other one, the latter will be set free and the one blamed would serve 5 years of prison time.

The table below shows the possible playoffs:-

Suspect B / Suspect A	Remain silent	Blame
Remain silent	1 1	0 5
Blame	5 0	3 3

Figure 1: Table showing possible playoffs

Literature Review

The middle ground between ancient and modern game theory was made to metamorphose thoroughly, if not formalised, in Gerolemo Cardano's infamous book 'The Book on Games of Chance: The 16th-Century Treatise on Probability, published in 1663. Works like Augustin Cournot's Researches into the Mathematical Principles of the Theory of Wealth, Francis Ysidro Edgeworth's Mathematical Psychics and Emile Borel's Algèbre et calcul des probabilités made a huge impact on advanced studies and discussions on game theory (Walker, 2001a). They created a strong base for mathematicians and economists later on to systematise and approbate game theory.(Schwalbe & Walker, 2001a)

In 1912, Ernest Zermelo gave two talks in the Fifth International Congress of Mathematicians in Cambridge. The second speech was on the game of chess which prompted him to write a paper on game theory named "Über eine Anwendung der Mengenlehre auf die Theorie des Schachspiels". It was published in 1912 and was written in Dutch. This is said to be the first paper ever written on game theory. Being a chess player, Zermelo wanted to prove how this theory works in the game of chess. His theorem states "either White can force a win, or Black can force a win, or both sides can force at least a draw". He used backward induction to prove his theory. (Schwalbe & Walker, 2001a)

A number of works on the theory of games were published in 1921 by French mathematician Emile Borel. He discussed the issue of bluffing and second-guessing the opponent in a game with incomplete information using poker as an example. (Theory of Games of Strategy)
Then came the Zeuthen bargaining model in 1938, which occupies a prominent place among those theories of the bargaining process that have been formulated and expounded by economists. (Coughlin, 1992)

And then finally came the giants- Neumann and Nash. Although many people have made contributions to the history of game theory, it is generally agreed that John von Neumann started modern analysis and that John Nash gave it its methodological foundation.

This article significantly advanced the subject. Von Neumann introduced the topic of game theory for the first time in his 1928 work, "Theory of Parlor Games," which also established the renowned Minimax theorem. Von Neumann anticipated that game theory would be a significant tool for economists. To establish his hypothesis, he collaborated with Princeton University economist Oskar Morgenstern, an Austrian (cournot)(MATHEMATICAL PSYCHICS)(Schwalbe & Walker, 2001).

The discipline of economics was dramatically altered by their work. The book's applicability to psychology, sociology, politics, military, leisure activities, and many other areas quickly became clear, despite the fact that it was originally only meant for economists.

In 1950, John Nash, an American mathematician, came up with the Nash theory, which stated: "a situation in which a player will continue with their chosen strategy, having no incentive to deviate from it, after taking into consideration the opponent's strategy." (*GAME THEORY-NASH EQUILIBRIUM AND ITS APPLICATIONS*, 2015b)Game theory booms after this. One of the greatest developments in social science was the creation of noncooperative game theory was done by John Nash. (PINTO)To better comprehend how the core concepts of noncooperative game theory were established and how they altered the history of economic theory, Nash's work in this field is reviewed in its historical context.

In 1971, the international journal of game theory was started.

In 1972, John Maynard Smith, a British mathematician applied game theory to animal behaviour and with Price, he proved that game theory is also used in the evaluation of the species. They wrote the book " Game theory and the Evaluation of Fighting".

In the last quarter of the twentieth century and early 2000s, Game theory paid special attention to the formulation of dynamic models. In 2007, Roger Myerson, alongside Leonid Hurwicz and Eric Maskin, was awarded the Nobel prize in Economics "for having laid the foundations of mechanism design theory" with game theory structure and its design. Roger Myerson has provided a clear and thorough examination of the models, solution concepts, results, and methodological principles of noncooperative and cooperative game theory. Myerson introduced, clarified, and synthesised the extraordinary advances made in the subject over the past fifteen years, presents an overview of decision theory, and comprehensively reviews the development of the fundamental models with games in extensive form and strategic form.(Myerson, 2025)

In 2005, game theorists Thomas Schelling and Robert Aumann won the Bank of Sweden Prize in Economic Sciences.

Dynamic models, the earliest applications of evolutionary game theory, were a focus of Schelling's work. (Pinto, n.d.)Aumann made significant contributions to the equilibrium school, creating a coarsening correlated equilibrium and a thorough investigation of the presumption of general knowledge.

For "laying the basis of mechanism design theory," Leonid Hurwicz, Eric Maskin, and Roger Myerson were given the 2007 Nobel Prize in Economics. A significant graduate text, Game Theory, Analysis of Conflict, and the idea of appropriate equilibrium are among Myerson's accomplishments. Hurwicz first proposed and formally established the idea of incentive compatibility.

For "the theory of stable allocations and the practise of market design," (MATHEMATICAL PSYCHICS, n.d.)Alvin E. Roth and Lloyd S. Shapley received the Nobel Prize in Economics in 2012.

Shapley is generally considered one of the most important contributors to the development of game theory. Shapley won the 2012 Nobel Memorial Prize for "The theory of stable allocations and the practice of Market design" along with Alvin E. Roth.

He elaborated on how some market participants cannot be divided a priori between a buyer and a seller. When the price of a product fluctuates, in some cases, one participant can be the seller and the buyer. Stocks are a clear example of commodities exchanged in such markets. However, in a market without this property: participants are either buyers or sellers, regardless of the price of the goods. Physical or the legal characteristics of the participants also make them be on the unique sides of the market (ddd.uab.cat/record/174208) (Jordi Massó Dept. d'Economia i d'Història Econòmica Facultat d'Economia i Empresa Universitat Autònoma de Barcelona 08193 Bellaterra, n.d.).

Shapley also collaborated closely with his friend mathematician and game theorist Robert Aumann. Together, the two defined the Aumann-Shapley value. It was built upon Shapley's most famous work, the Shapley value, which is a way of evaluating a game situation before the game gets played.

Jean Tirole, a game theorist, received the Nobel Prize in 2014.

A total of 15 game theorists have won the Economics Nobel prize.

RESEARCH METHODOLOGY

This paper uses bibliometric methods to analyze existing literature related to Operations Research, Game theory. For this paper, different documents were retrieved from databases such as Science Direct, Z-Library, and Google Scholar. These papers were downloaded on Mendeley and curated into a small database. This study aims to review and understand the relationship between game theory in conflict management through the lens of Operations Research.

Furthermore, a subtopic given added importance is conflict management while using application-based game theory. To retrieve data and analyze existing literature, related to game theory and conflict management, we also implemented important keywords in our search on ScienceDirect.

To gather information relevant to our research topic, a keyword search was conducted on Scopus. The keywords used were "Game theory" AND "Conflict" AND "Management" AND "Solutions". Conference papers, books, book chapters and conference reviews were all excluded in order to filter the database. Furthermore, only journals, reports and research papers written in English were considered, which resulted in a sum of 250 articles and reviews spanning all subject areas.

Using VOS viewer (Visualizing Scientific Landscapes, 2018), a co-word analysis of the keywords found in the title, abstract, and author-provided keywords was carried out in order to understand the main study areas of the published papers by identifying the connections between the keywords.

To understand the knowledge structure of the research field and drive future research questions, we conducted a collateral analysis of keywords frequently used in econometric literature survey studies. To perform code analysis, bibliographic information was downloaded from ScienceDirect into text files and used as input for code analysis in the VOS viewer. Keywords that appeared frequently in titles, abstracts, and author-provided keywords were selected for further analysis. Keyword mismatch (singular and plural, British English and American English spellings, etc.), the thesaurus files in VOSviewer during analysis to ensure keyword consistency. Finally, a general word network was generated by including keywords that appeared at least three times in the article set.

ANALYSIS

Keywords Used in Papers

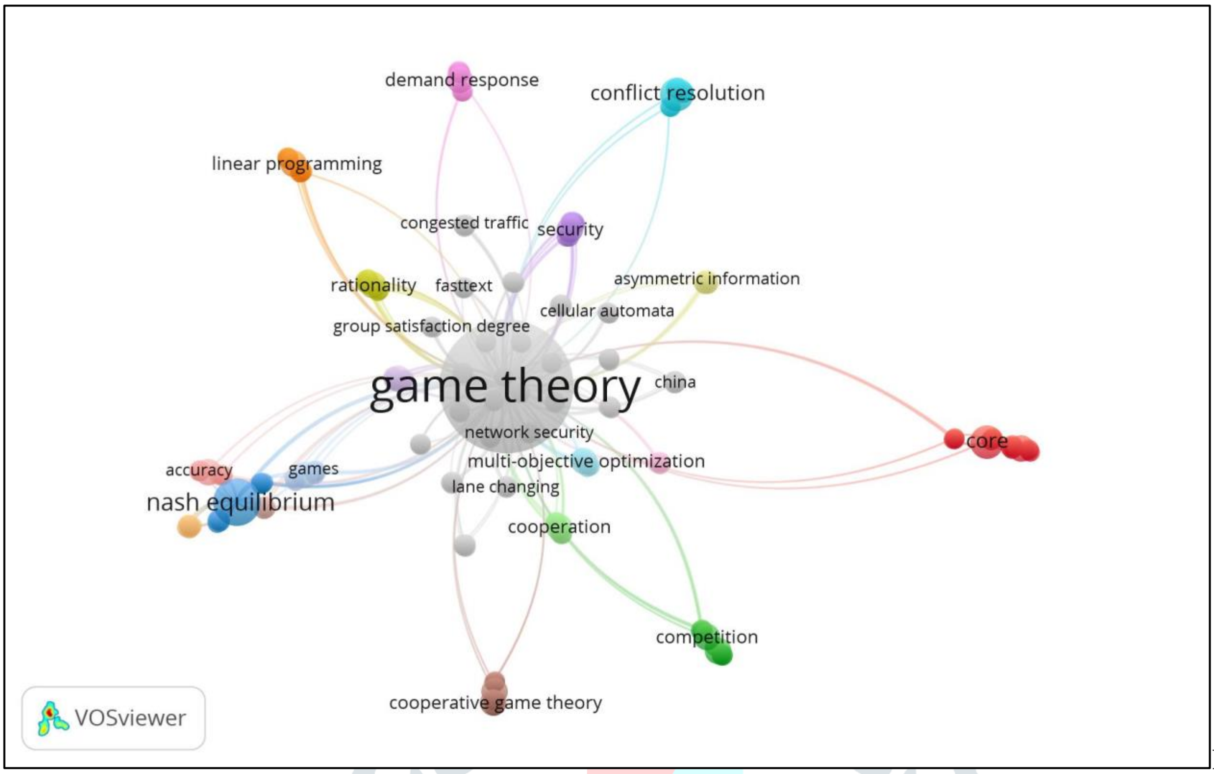

Figure 2: Network graph of research papers

So far we've learnt that game theory is extensively used in the field of business, strategy, firm behaviours etc. Using a software, we shall now determine the keywords used in nearly 250 research papers which we've gone through. The major keywords used in the research papers, which we shall discuss further are-

1. Crisis: To analyse the relation of game theory with 'crisis', we shall briefly talk about the Cuban missile crisis of 1962. A Soviet attempt to place medium- and intermediate-range nuclear-armed ballistic missiles in Cuba that could strike a significant portion of the United States in October 1962 served as the catalyst for the Cuban missile crisis. The United States sought the prompt removal of Soviet missiles, and American policymakers gave two approaches substantial consideration. The approaches were –

    A naval blockade (B), or "quarantine" as it was euphemistically called, to prevent shipment of more missiles, possibly followed by stronger action to induce the Soviet Union to withdraw the missiles already installed.

    OR

    A "surgical" air strike (A) to wipe out the missiles already installed, insofar as possible, perhaps followed by an invasion of the island.

The alternatives open to Soviet policy makers were:

1. **Withdrawal (W)** of their missiles.
2. **Maintenance (M)** of their missiles.

		Soviet Union (S.U.)	
		Withdrawal (W)	Maintenance (M)
United States (U.S.)	Blockade (B)	Compromise (3,3)	Soviet victory, U.S. defeat (2,4)
	Air strike (A)	U.S. victory, Soviet defeat (4,2)	Nuclear war (1,1)

Figure 3: Figure explaining possible tactics during Cuban crisis

These strategies may be thought of as many routes that the two parties, or "players" in game theory speak, could pursue. The four outcomes are to be ranked by the participants as follows: 4 = best, 3 = next best, 2 = next worst, and l = worst. As a result, as the number rises, so does the reward. The payoffs, however, are only ordinal, which means that they don't reflect how much a player favours one occurrence over another but rather the ranking of events from best to worst. The first number in each set of ordered pairs represents the payout for the row player (the United States), while the second number represents the payout for the column player (Soviet Union). It goes without saying that the strategy decisions, likely outcomes, and related payoffs depicted in Figure 1 only give a basic overview of the crisis's thirteen-day evolution. Both parties thought about various modifications on each of the two mentioned options in addition to the other options. For instance, the Soviets asked that the United States remove its missiles from Turkey in exchange for them removing their own missiles from Cuba. The United States publicly disregarded this demand. (docplayer.net/52603373-Game-theory-and-the-cuban-missile-crisis.html)

Although one book detailing this nuclear conflict had "collision path" in the title, most observers of this crisis believe that the two superpowers were on it. President Kennedy was pressured by the Union to vow not to invade Cuba at the same time, which seems to suggest that a compromise of sorts was reached in the end. However, since the strategies connected to compromise do not make up a Nash equilibrium, this is not what game theory predicts for Chicken. (docplayer.net/52603373-Game-theory-and-the-cuban-missile-crisis.html)

To see this, pretend that play is at the compromise position (3, 3), which is when Cuba and the S.U. are both under American blockade. pulls back its missiles. Due to the motivation for both players to switch to their more combative tactic, this strategy is not reliable. Play would shift to (4,2) if the U.S. defected by switching to an airstrike strategy, enhancing the reward for the U.S.; if the S.U. play would shift to (2,4) if the S.U. deviated by switching to maintenance, offering the S.U. a 4. payout. Last but not least, if the players were facing nuclear war, which is the mutually worst consequence of (1,1), they would both undoubtedly want to flee from it, rendering the strategies related to it unstable, just like those with (3,3). (plus.maths.org/issue13/features/brams/feat.pdf, n.d.)

3. Cheap Talk- "Cheap talk" is the term used in game theory to describe activities that are visible to players but have no direct impact on their payoffs (Dixit, Jan 2011). These are referred to as "messages." (These messages should be separated from those that are sent within the context of a contract and do have immediate outcomes and payoffs, such as a bid in an action, as well as from those that transmit verifiable information, such as submitting a college transcript, with the possibility of significant penalties for falsification (Jamison, Aug 2020) . Since "cheap talk" messages have no immediate reward effects, any equilibrium in the game that existed before the addition of cheap talk continues to exist merely by allowing senders to transmit useless messages and allowing recipients to ignore them (clearly, those strategies are best responses to each other). They are referred to as "babbling" equilibria. As long as the sender randomises so that every potential message is sent with a positive probability, these equilibria are not eliminated by the standard refinements. (However, several unique improvements have been proposed for games involving cheap talk; see, for instance, Farrell's "neologism-proofess").

   While doing so, cheap conversation can create intriguing new equilibria. Games of shared interest are the most straightforward example, where complete communication achieves equilibrium and results in a better payout than if cheap talk is prohibited (Sidartha Gordon, March, 2021). At the other extreme, it is simple to see that idle discussion cannot add equilibrium results in a two-player game of competing interests (often known as a zero-sum game). Of course, the scenarios that involve partial but not total interest congruence between participants are the most interesting. For instance, the divergence of interests between the sender and the receiver is parameterized using a "bias" in the renowned Crawford-Sobel model (Crawford & Sobel, Nov 1982). Applications of cheap talk include asking informed but biassed experts for advice, politicians communicating with their constituents and with one another, businesses dividing the market through communication, news media stories, and international communications, among others. A "long-run" player would aim to establish a reputation for a message approach, it should be added. For instance, you want to build a reputation for not crying wolf too frequently so that when you do, the people would believe you when you do and come to your aid. According to Kamenica and Gentzkow, communication involving this level of commitment from the sender is known as "Bayesian Persuasion" and typically results in significantly more communication than conventional small talk.(Amadae, 2018)

4. Game Theory- A game theory concept known as Nash equilibrium finds the best course of action in a non-cooperative game in which each participant has no incentive to alter their starting strategy. Assuming that the other players maintain their initial plans, a player does not benefit from changing their approach under the Nash equilibrium. There could be several Nash equilibria in a game, or none at all.

Sam and John are signing up for the upcoming semester. Both of them have the choice of either a psychology or finance course. They don't have time to talk to one another because there are only 30 seconds left before the registration deadline. (Myerson, March 1999)

Sam and John will gain from the chance to prepare for the tests together if they enrol in the same course. They will both lose out if they select different classes, though.

There are several Nash equilibria in the example. Sam and John will benefit from studying together for the exams if they sign up for the same course. Therefore, in this situation, the outcomes finance/finance and psychology/psychology are Nash equilibria.

John \ Sam	Finance	Psychology
Finance	1, 1	0, 0
Psychology	0, 0	1, 1

5. Competition- A and B, two computer companies, intend to market network systems for offices. handling of information. Each business can either create a quick, effective system (H) or a sluggish, subpar system (L).

		Firm B	
		H	***L***
Firm A	***H***	**30, 30**	**50, 35**
	L	**40, 60**	**20, 20**

According to market studies, the resulting revenues will. The following payoff matrix is provided for each business in relation to the possible tactics. If both firms make their decisions at the same time and follow maximin (low-risk) strategies, what will the outcome be? With a maximin strategy, a firm determines the worst outcome for each option, then chooses the option that maximizes the payoff among the worst outcomes. If Firm A chooses H, the worst payoff would occur if Firm B chooses H: A's payoff would be 30. If Firm A chooses L, the worst payoff would occur if Firm B chooses L: A's payoff would be 20. With a maximin strategy, A therefore chooses H. If Firm B chooses L, the worst payoff would occur if Firm A chooses L: the payoff would be 20. If Firm B chooses H, the worst payoff, 30, would occur if Firm A chooses L. With a maximin strategy, B therefore chooses H. So under maximin, both A and B produce a high-quality system. (www.coursehero.com/file/119362850/Team-4-Game-Theorypptm/, n.d.)

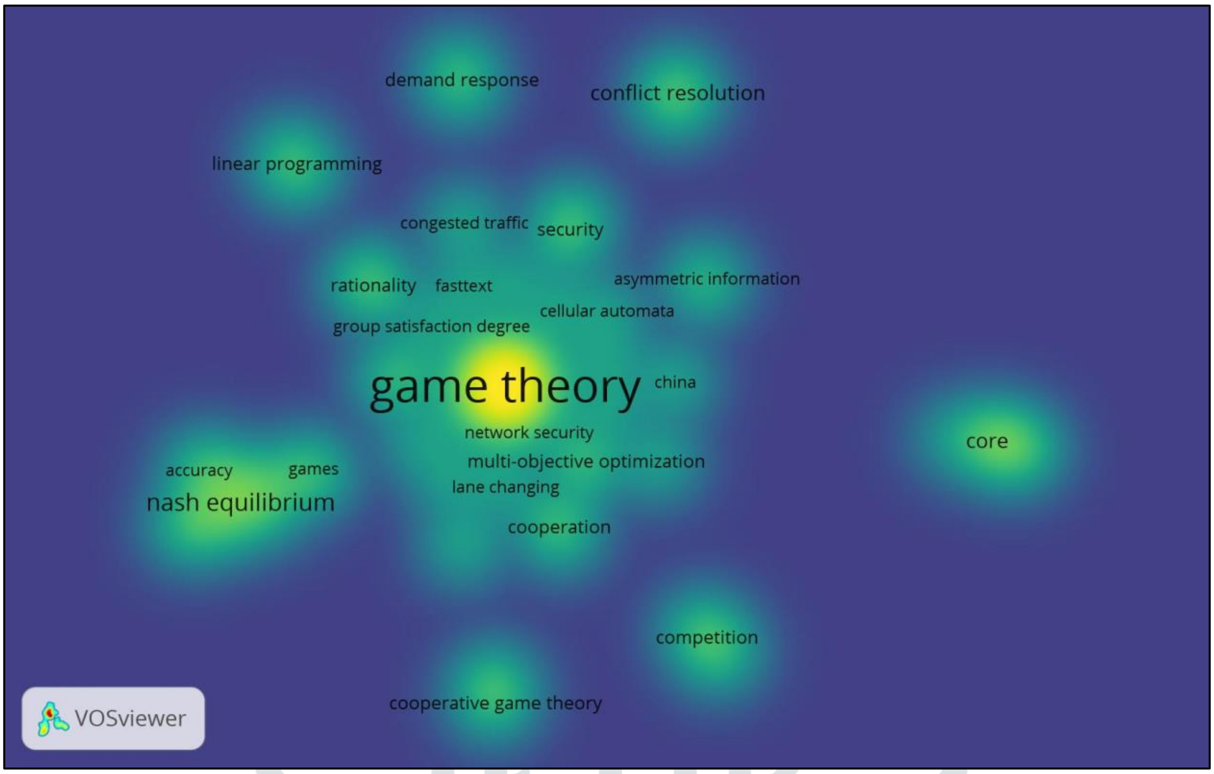

Figure 4: Density Graph of the keywords

The definition of a density graph is “Density plots are used to study the distribution of one or a few variables. Checking the distribution of your variables one by one is probably the first task you should do when you get a new dataset. It delivers a good quantity of information.”

In the density graph obtained in our game theory research, we will explore the 2 most recurring words (variables)-

1. Demand Response- Demand response (DR) is widely acknowledged as an efficient way to lessen the strain placed on power systems (Khaled Alshehri, 2020). The decision-making procedures in grid operations become much more difficult as new concepts develop since DR causes a variety of interactions among numerous emergent entities. Due to its capacity to deal with challenging decision-making issues, game theory (GT) has recently attracted a lot of attention in the field of disaster risk management. For tackling various DR concerns, a number of theoretical GT-based techniques have been put forth, however it is still unclear whether these theoretical approaches can actually be implemented in practise. We first give detailed instructions on how to build a DR-oriented facility, and then we investigate the efficacy of applying a Stackelberg game theory-based DR algorithm to manage the energy consumption of the facility, where the energy management centre (EMC) serves as the leader and numerous devices act as the followers. This approach aims to close the gap between theoretical studies and practical implementations. The experimental assessment results demonstrate that the GT-based DR algorithm performed admirably in real-world DR management, including peak load reduction with a peak-to-average ratio (PAR) of 1.59 and optimal load control in response to real-time price (RTP).(Tang et al., 2019)

2. Conflict- In society, there will always be conflict between those who have different demands and values. Although there are many different definitions of conflict, it is clear that every researcher agrees on the significance of reason and pattern in conflict. Relationship and task conflict were categorised by Jehn, and Pondy came to the conclusion that conflict processes included latent, perceived, felt, manifested, and aftermath conflicts. The disparity of goals and limited resources contributes to a latent conflict. Drives for

autonomy can occasionally lead to conflict in organisations; this process is known as perceived conflict and occurs when one or more parties become aware of the possibility of conflict. In the end, reactive interactions between contending parties have an impact on the aftermath of the conflict. Conflict management is the style of handling conflict and the control of conflict. Administrators should manage interpersonal disputes as well as organisational ones; various people may manage conflicts in different ways. According to the two aspects of assertiveness and cooperativeness, there are five alternative techniques to managing disputes (Blake and Mouton, 1964).

3. <u>Construction Management</u>- In the construction industry, researchers have applied various game theory models to explain and predict outcomes. Ho (2001) used game theory to analyse the procurement process of project construction, operation, and delivery in the presence of asymmetric information and its impact on project funding and government policy. Drew and Skitmore (2006) used auction theory, a subfield of game theory, to analyse the bidding process in the construction industry. Ho and Liu (2004) used a game theory model to analyse the dynamics between contractors and owners in building claims. Karl (2014) developed his approach to modular-oriented modelling that can be used to simulate multi-causal and dynamic relationships at various levels in the construction industry.(Ahmed et al., 2016). (ascelibrary.org/doi/10.1061/%28ASCE%29CO.1943-7862.0001058)

The circumstance when the bidder with the most optimistic (low) project cost estimate wins the project contract based on a submitted bid less than the actual project construction cost is known as the "winner's curse," especially in the construction sector. Such a bidder, who disregards the winner's curse issue, is likely to generate negative or at the very least, below-average earnings. (2016) Ahmed et al. Additionally, game theory has been used to examine subcontractor selection methods and to examine the effects of bid compensation on competitive bidding procedures (Unsal and Taylor , 2011), (Ho, 2005).Therefore, it is believed that game theory is a crucial instrument for studying various issues in the building sector. (2016) Ahmed et al. (ascelibrary.org/doi/10.1061/%28ASCE%29CO.1943-7862.0001058)

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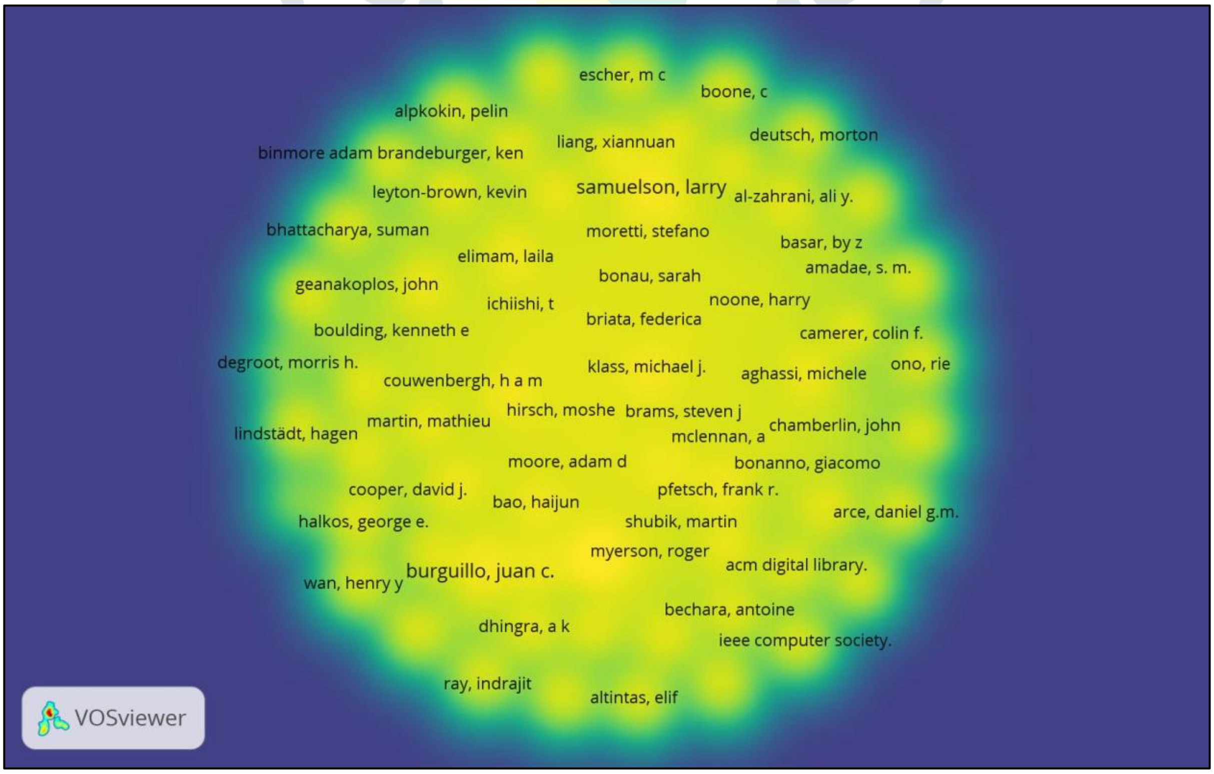

1. John Nash: Mathematician John Forbes Nash Jr. was from the United States. He was born in 1928 in West Virginia and was a pioneer in the study of differential geometry and partial differential equations. Additionally, he created the Nash Equilibrium, a theory of equilibrium using the well-known prisoner's dilemma as an illustration (Kuhn et al., 1996). Together with two other people, Nash shared the 1994 Nobel Prize in Economics for developing the mathematical underpinnings of game theory. The most important contribution Nash made to game theory was to broaden the field's potential applications and studyable scenarios. Before his work, the area was mostly focused on a particular subset of issues that were subject to very rigorous regulations. He broadened them and showed how these ideas might be applied much more extensively, expanding the discipline's previous narrow focus. Much of what came after in game theory could not have been conceivable without his innovation. His name lives on as his most enduring legacy. He demonstrated that there is always at least one position in a game when each player has a limited number of options from which to choose, and in which no single player can better his or her position only by switching strategies. A "Nash equilibrium" is the name given to such a location. The evidence is that there is always "a situation in which everybody is doing the best they can, given what everybody else is doing," in the words of economist Samuel Bowles.(*GAME THEORY-NASH EQUILIBRIUM AND ITS APPLICATIONS*, 2015b)

The problem is that a Nash equilibrium does not always imply that everyone gets the optimal result. It simply indicates that no one can advance in life because they are powerless to influence others' decisions.(*GAME THEORY-NASH EQUILIBRIUM AND ITS APPLICATIONS*, 2015b)

2. Neumann and Morgernstern: Perfect Foresight and Economic Equilibrium was a 1935 work by Oskar Morgenstern that led his colleague Eduard ech to recommend John von Neumann's Zur Theorie der Gesellschaftsspiele (1928)(Poundstone, 1993). Austria was annexed into Nazi Germany when Morgenstern was at Princeton University in 1938, and he made the decision to stay in the United States. He would even live out the remainder of his days here after becoming a citizen in 1944. Morgenstern was given a full professorship at Princeton soon after, although he favoured the Institute for Advanced Study. He reconnected with John von Neumann there, and the two of them wrote the renowned Theory of Games and Economic Behavior, which was published in 1944 and is regarded as the founding work of game theory(*The Collaboration between Oskar Morgenstern and John von Neumann on the Theory of Games*, n.d.). A mathematical framework called game theory is used to examine strategic structures that direct rational choice in specific economic, political, and military contexts. This book used competitive business circumstances to apply John von Neumann's theory of games of strategy. What role von Neumann actually performed in the project is up for debate. The majority of the scientific representation is currently thought to have been created by John von Neumann.

3. Larry Samuelson: One of the most active and quickly expanding fields of economics research is evolutionary game theory(Samuelson, n.d.). Evolutionary models hold that people choose their strategies through a trial-and-error learning process in which they gradually learn that some strategies work better than others, in contrast to traditional game theory models that hold that all players are fully rational and have complete knowledge of all game details(Samuelson, 1996). Low-payoff strategies typically get eliminated in games that are played repeatedly, and an equilibrium may develop. One of the key authors in the literature on evolutionary game theory is Larry Samuelson. He analyses how the equilibrium selection issue in noncooperative games and evolutionary game theory interact in his book Evolutionary Games and Equilibrium Selection.(Samuelson, n.d.)

4. Paul Milgrom and Robert B. Wilson: They described human cooperation in the final repeated prisoner's dilemma experiment. According to traditional Nash equilibrium analysis, players do not cooperate in this game, but experimental evidence refutes this prediction. Human players are mostly able to cooperate towards the end of the game. Our theory worked differently. There is nothing to be confused about cooperation if cooperation and reciprocal behavior can make others expect cooperation. Criticism of our

approach soon turned into praise. The National Academy of Sciences recognized this achievement when it announced the 2018 Carty Award for Scientific Advancement. Our work has created powerful new tools that enable game theory to analyze economic institutions and human behavior.

DISCUSSION

The discussion revolving around Game Theory is certainly an interesting one. Interpreting papers all the way from Gerolemo Cardano's 'The Book on Games of Chance' of 17th century to breakthroughs made in mid 20th century to latest findings.(Schwalbe & Walker, 2001b) A subclass of optimality modelling, game theory is useful when interactions are frequency dependent. The strategy consists of two crucial components. First, it is expected that specific behavioural patterns will endure in a community as long as mutants incapable of adopting different behaviours cannot infiltrate(Camerer, 1997). Evolutionarily stable techniques are known as such stable combinations. The maximum of fitness measures in optimality models are all ESSs within the environment in which they are acceptable, hence the idea of the ESS is not exclusive to game theory. Second, each kind must have a certain gain or loss in fitness while interacting with another person. We calculate the predicted payoff for each activity using this payoff matrix. (Ray & Zhou, 2001)

CONCLUSION

Strategic management must incorporate ideas from several scientific disciplines in order to advance our understanding of the interactions between organisations and the complexity of the world managers must navigate. In this essay, we prioritise game theory as one of the axes most likely to enhance the dominant strategic management methodology. The manager's interest in game theory hinges on how practical the tools are and how much they can be applied to difficult, real-world circumstances.

Our opinion is that game theory may be especially effective at elucidating the decision-making process and, in some instances, it can help with decision-making in complex situations where various actors (people, businesses, and governments) interact in a setting that is marked by a high level of strategic interdependence. We have demonstrated how corporations can better comprehend the behaviour of their competitors and adjust their strategy by looking at a variety of game circumstances (one-shot games, recurrent games in a finite or an infinite setting, coalition formation). (wang c, 2019)

Game theory is not a replacement for managers' actual business experience, though. They frequently make more "qualitative" and "intuitive" decisions. Above all, game theory aids managers in fusing their aptitude and capacity for "real-world" perception with a variety of more analytical approaches. The phrase "to establish and lead a plan, the spirit of geometry and the spirit of finesse must play a duet" is taken from [CHA 02].

Decision-making in situations with two or more protagonists, who are frequently driven by different or even opposing goals, can be rationalised with the aid of game theory. Other opportunities for "cooperation" or "coordination" may also emerge and, in fact, constitute legitimate options that lead to collectively better solutions, even in settings where interests may seem incompatible and "conflict" seems to be the norm. We have seen how decisions taken in the setting of noncooperative games can lead to the creation of strategic coordination, which does not always require the establishment of an explicit agreement between the players. These various cooperative and noncooperative approaches to cooperation, as we have seen in a chapter of this book, present a very broad range of opportunities for the advancement of managerial strategic thinking.

Contrarily, while game theory has been used in many disciplinary subjects (such as biology, law, politics, international relations, sociology, and economics), it has only just begun to make inroads into the field of strategic management, one of the management sciences. However, there has been an upsurge recently in papers demonstrating the connections between game theory and strategy as it is currently taught in university courses. This book makes an effort to capitalise on this fresh zeal by carrying on the process started in the first book. We have attempted to demonstrate that game theory principles may be quite helpful in offering an

innovative analysis grid for the result of various specific events, whose lessons can be very educational for managers, using case studies indicative of current strategic management concerns. Through a few instances, we have also demonstrated how economic issues can serve as study cases in strategic thinking for managers as well as for private or public decision-makers even when they are addressed using a theoretical toolkit that is a priori difficult to access by the general public. To achieve this, the logical framework and the findings must be translated in a way that allows them to fit into the traditional strategic management analysis grid. From this vantage point, the spirit of this strategy should be more frequently applied to the most current advancements in economic research. Future robots will need to collaborate in order to complete jobs. Game theory is one method to offer coordination, which is necessary for the robots to function well as a team. The fundamentals of game theory are covered in this level. Robot teams may now cooperate to perform tasks because to developments in automation and control. When robots cooperate in this fashion, each robot's activities have an impact on the team's overall performance. Therefore, a coordinating mechanism amongst the robots is required if they are to function autonomously. Such a mechanism is provided by game theory.
Each robot is viewed as a player in a game in game theory, and it receives prizes based on its performance .According to game theory, each robot will benefit from cooperative effort if it completes the task at hand. In order to maximise the incentives for each robot and the team as a whole, the team must work together to discover a coordinated solution. (htt) (https://onlinelibrary.wiley.com/doi/pdf/10.1002/9781119419761.oth1)

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