EVALUATING PREREQUISITES TO COLLABORATIVE STRATEGIC DECISIONS: A SIMULATED COLLABORATIVE SCENARIO OF TWO ACTORS

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Abstract – *This paper conceptualizes different grounds for collaborative decisions in order to forecast how different behaviors behave in a game-theoretical prisoner's dilemma (PD). Forecasting is facilitated by a simulated scenario between two actors. The paper views consequences of different behavioral strategies and underpins an evaluation through analyses of the game, and also presents a unique aggregated analysis modeling strategic behavior on the basis of game-theory. The paper suggests that game-theory could be a potential and powerful tool for researchers and practitioners struggling with the strategic dilemmas, i.e. trust-building versus opportunistic behavior in inter-firm cooperation. The paper outlines some strategic principles that may unsettle the dilemma situation through either social or formal contracts.*

Keywords: Game-theory, strategy, decisions, Prisoners dilemma,

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1. INTRODUCTION

A starting point for this paper is that decisions render in positive or negative consequences and that every consequence render in new experiences. Today rapidly changing competitive arenas reaching beyond firms' administrative, functional and local environments highlight a growing need for accurate applications for decision making. From previous studies we know that misjudging decisions' context may have serious future consequences (Kadane and Larkey, 1983). Enhanced understanding of consequences in beforehand and analyzing them systematically should thus be a valuable base for decision-making and development of future strategies. From management literature tailored in game-theory we know buffer knowledge in learning procedures is important for developing potential future advantages (Lieberman, 1987). As businesses struggle with finding proactive and reactive strategies, they often hesitate about whether a decision is correct and thus includes the potential of future benefits.

Theories systematically "fishing out" durable solutions basically rely on Simon (1955) and his theory of rational decision making. Systematic decision-making was later developed into another kind of rationality, "satisfying decisions" labeled as bounded rationality (Simon, 1964). Satisfying decisions do not estimate the consequences exhaustively; nor the underlying mechanisms underpinning the consequences of decision-making; and neither consider all conceivable alternatives. Decision-making based on "satisfying" rationality is understood to be more functional for survival in certain strategic domains. For instance, different cultures are more or less tolerant towards strictly opportunistic rational behavior.

Per se decisions refer to the *"problem solving process, the sensing, exploration, and definition of problems or opportunities – as well as generation, evaluation and selection of solutions (Huber and McDaniel, 1986, p. 576)."* The definition explicitly outlines a procedure including mainly three different prerequisites:

1. Sensing and exploration of problems and opportunities;
2. evaluation and;
3. selection of solution

Per se decisions thus explore opportunities, evaluate the opportunities to select a suitable solution. However, Child (1972) emphasizes that managers tend to not work hard enough to explore all opportunities available to find the best solution. Penetrating such different options may be perceived as an abstract procedure where hardly any tool except game-theory really unveils the bottle-necks and tries to forecast how the potential or existing counterparts may act upon a decision. As one of few tools, game-theory facilitates to bridge behavioral aspects to strategic decision-making (Axelrod, 1984; Zagare, 1984). A critique towards game-theory arises from unrealistic assumptions emanating far from the actual competitive arena (Camerer, 1991; Saloner, 1994; Porter, 1981). The real challenge seems thus to be finding empirical evidence or theoretical constructs of strategic behavior close enough to the real situation.

A hot strategic topic for decision makers of late refers to whether a firm should collaborate or not collaborate. Strategic decision-makers work hard to master whether one will benefit or basically gain disadvantage from a future collaborative partner. Strategic decisions regarding collaboration also consider if your future partners' behavior could be synchronized to ones own incentives and interests. Different theories in circulation regarding decision behavior postulate a number of axioms as critical for maintaining collaboration:

(1) Tichy and Tushman and Fombrun (1979) studied different behavioral aspects in social networking and characterized reciprocity as one necessary prerequisite for collaboration to emerge. Per se reciprocity is the degree to which a firm may expect reverse benefits as

contributed from a continuous exchange in a certain shared context. Since reciprocity regulates an expected future benefit in the mind of a counterpart, it also starts the imagination about the length of the agreed relation. Well developed reciprocity hence regulates future obligations where the intense relations always take into account a received benefit as reverse compensation. Reciprocity is also a main characteristic in well established game-theoretical vocabularies. For instance, a tit-for-tat behavior instantly follows a counterpart's behavior to base future action upon (Axelrod, 1984). On the contrary a less developed reciprocity may suffer from not being confident about whether the counterpart will let the corresponding person down.

(2) Trust is also established as an explanation to how successful collaboration is maintained. Trust itself facilitates well estimated outcomes of ones counterparts' behavior. Developing trust is hence a valuable technique for assessing and controlling the degree of risk (Mayer, Davis and Schoorman, 1995) involved in the strategic collaborative scenario. Established trustful partners symbolize a past which have regulated misconduct by punishing undesired behavior and rewarding a favorable behavior. Such a regulating process is normally based on some agreed values, norms and shared ideas about the future. By constituting multiple explicit or implicit rules, the behavior is expected to be more stable over time. However, it may be functional only in e.g. "familiar environments" where a high degree of social control may control the agreed wills embedded in the social contract, i.e. irrational behavior such as altruism, generosity, cooperativeness, integrity, truthfulness (Jones and Wicks, 1999). Instead a well established social control (Jones and Wicks, 1999) and empathy (Sally, 2001) are probably better suited to maintain a control over such a behavior.

(3) The situation is also dominated by the amount of resources each party will invest in order to ensure for collaboration to emerge. Estimating the amount of resources could be approached by simply thinking in terms of cost benefit calculations. The cost benefit calculation comes out of alternative thinking. A decision to collaborate always has the alternative of not collaborating and vice versa. Again, the consequences of the decisions will be evaluated in terms of consequence costs of the decision. Serving a customer may for instance require more capital and hence more risk, while sharing risk may render less profit but also less risk. Sharing customers may also increase customers' perceived value, but may also be hazardous if the collaboration part is not trustworthy. Understanding the value of a gain or loss of a future relation requires an estimation of the length of the game together with a discount parameter estimating the value of a decrease or increase on the total amount.

(4) Salveson (1958) approached managerial decisions from a reconciliation procedure between to contradictory elements: opportunistic versus trust-based interests. Opportunistic behavior may be undestood as a personal interest legitimate long-run sustainability for short-termed benefits. Per se opportunism could be "self-interest seeking with guile." (Hill, 1990, p. 500). Actors focusing on self-interests tend to open relations with cheat, either in order to lubricate rigid positions or to minimize risk by preventing themselves from being undesirable exploited. Williamson (1979) shed light on how a risk-avert behavior may favor from sheltering high investments by initially being monitored by contracts as a conjunction to a more trust-based relation. Granovetter (1985) is, on the other hand, sceptical to contractual relations since lawyers quickly decompose agreements by simply referring to a different understanding. Instead Granovetter noted that distrust is prevalent in selfish cultures and hence an acceptable phenomenon.

Kirchkamp (2000) found that complex strategies tend to foster cooperation. From a game-theory perspective we know that difficulties with collaboration arise from a large number of behavioral aspects (Axelrod, 1984). Interfirm networks able to develop and sustain trust may hence unsettle strategic dilemmas, where a long-term outlook and awareness about receiving reciprocity underpin a sustainable advantage. Interfirm networks in the process of developing trust may initially perceive the business relation as any transaction to protect themselves from downside risk, and use the relationship created as an opportunity to signal their intent and committment in their partners' (Gulati, 1998).

Generally game-theory is accused of oversimplifying the reality, and thus procedures of organizational strategic decision-making. How can game-theory then come closer to real management? Different behavioral constructs with more or less trust versus more or less opportunistic behavior still seems to represent endless dilemmas to what constitute success in management. Is game-theory a tool powerful enough to understand the dilemma of trust versus opportunism? This is an intriguing question to be addressed in this paper. The behavioral constructs in this paper represent (more or less) rational and/or (more or less) functional irrational decision behaviors. The constructs are tested and analyzed in two games respectively. The analyses are carried out using four different mathematical perspectives: (1) pessimistic perspective; (2) optimistic; (3) maximizing opportunities; and (4) using a weight average to base the decision on. First, however, we will get acquainted with some basic elements and assumptions of Game Theory.

2. THE PRISONERS DILEMMA GAME

Traditionally game-theory allows many different kinds of descriptions of the game, but a general rule is that type of analysis should determine the exhaustiveness of details (Schotter and Schwodiauer, 1980). An extensive form used in this article view specific details in the scenario, since it contains lots of different behaviors.

Is game-theory a method or a theory? Game-theory as a method refers to the evaluation of situations. Game-theory as a theory is a perspective to visualize and explore minds of other actors (Romp, 1997). Parkhe (1993) derived advantage from the game theoretic approach in structuring networks empirically (Parkhe, 1993). The collaborative issue presented in this paper also refers to game-theory. There are a huge number of motives to enjoy collaboration in different forms, and game-theory is a powerful tool used to evaluate the vulnerability of a strategic situation (Parkhe, 1993). Game-theory is also suitable to describe, explain and even make predictions of different strategies (Zagare, 1984). Prisoners Dilemma (PD) is probably the most analyzed game-theoretic situation (Zagare, 1984; Axelrod, 1984; Parkin, 1999b; Parkin, 1999a). The nature of PD still triggers researchers to find different solutions to unsettle the dilemma. PD refers to a situation where two players are caught in a dilemma represented by alternatives that will yield different outcomes depending on what risk each player is willing to take. Since both players in the PD are presumed to optimize their own outcomes (act rationally) the non-collaborative alternatives are outperforming the collaborating ones. From the perspective of the collaborative part, unsettling the dilemma should need strictly framed formal contracts or social contracts penalizing undesirable behavior.

Game-theory can be applied to an individual problem, but it can also appear as a proposition to solve a series of problems. Game simulations that conduct a chain of decisions are called iterated or repeated games. The weigh (W) of every decision is all important[1]. Of course the collective advantage also depends on the length of the interfirm network (Axelrod, 1984).

MATRIX 1: GENERAL ASSUMPTIONS FOR THE PD			
		PLAYER 2	
		Collaborate	Not collaborate
PLAYER 1	Collaborate	$R_2 = 8$	$T_2 = 9$
		$R_1 = 8$	$S_1 = 1$
	Not collaborate	$S_2 = 1$	$P_2 = 3$
		$T_1 = 9$	$P_1 = 3$

R_2 = Reward player one for mutual cooperation
R_1 = Reward player two for mutual cooperation
S_2 = Player two receives sucker's pay-off (player 1)
T_1 = Player one's temptation to not collaborate
T_2 = Player two's temptation to not collaborate
S_1 = Player one receives sucker's pay-off (player 1)
P_2 = Punishment of player two for non-collaboration
P_1 = Punishment of player one for non-collaboration

The simultaneous game in this paper is divided into two parts: a one-shot simple game and one iterated part. The simple game aims at bridging the understanding of the techniques used. The simple game contains just one snapshot game. The iterated game represents a chain of two simultaneous strategic situations. The games in this paper address a scenario between two players in a PD. The games are constructed very simply by assumptions appreciated in a PD matrix, and the consequences are being followed up in a tree diagram and by mathematical analyses. The simple issue is then followed by mathematical tests and analyzed towards a general theoretical framework. The scenario contains a case of two players selecting either to collaborate or not to collaborate. The players have access to the same information.

Notable is following:

MATRIX 2: NOTABLE OUTCOMES IN MATRIX 1			
	Best outcome	Worst outcome	Sum of the row
Non collaboration	9	3	12
Collaboration	8	1	9

These are the general assumptions in this game: The assumptions are derived from general requirements for prisoners dilemma. To facilitate a scenario including survival, the assumptions are tailored to allow players with "live and let live" strategies to survive. According to Axelrod (1984), the assumptions of live and let live will emerge if $R > (T+S)/2$. Secondly $T>R>P>S$ is included in every PD (Axelrod, 1984; Zagare, 1984). In other words, if R is larger than T + S there is an incentive to collaborate, because switching the formula to $R<(T + S)$ would give incentives to by turns defect (T) and also by turns to forgive the other part. The scores in the selected game are not empirically derived, but cover those necessary strategy terms this paper intends to explore. The upcoming analyses of this game will be undertaken with different weights (γ) with the purpose to even out the variance to some extent between the highest and

[1] Axelrod (1984) argues that weight of every single decision need to have a 0.5 or higher discount parameter given there is a shared domain for repeated collaboration.

lowest score. Another way could have been to let change the value of (R). Anyhow, to keep the live and let live strategy, (R) needs to have a value greater than 5.

3. SOME BEHAVIOURAL CONSTRUCTS APPLICABLE IN GAME - THEORY

Generally, the behavioural constructs represent individual strategies in game-theory. Constructing such a behavior from a counterpart aims at forecasting and understanding how different behaviours enact in different games. Collecting proof about behaviour also underpin more accurate predictions and risks involved in making business with the counterpart. Every strategy will be given an abbreviated attribute, which will enable the reader to follow the analyses. The attributes follow a general game-theory tradition to explore the best strategic decision behaviour.[2] This is also why it is becoming a tool interesting for both researchers and practitioners.

Strategy in game-theory is to undertake specific assumptions for each game and where these assumptions are impossible to change. If the assumptions are changed, the positions of players will be changed and there will be a whole new game. There are a number of different strategies (choices) that a decision-maker can undertake. In this paper the choices and prerequisites for the game will be presented according to the PD model.

3.1 NOTORIOUS DEFECTORS (ND)

Long run success through mutual collaboration is possible to endeavour through contracts or very tight relations based on trust (Parkhe, 1993; Sarbin, 1994). Agreements and relations not loaded with any kind of punishment for those breaking it, will run into risks to get exploited by a notorious defector. Notorious defectors will always defect in order to either ensure not to be trapped by someone else's defection and/or to ensure a minimum gain.

3.2 TIT FOR TAT STRATEGY (TFT)

Several different strategies are presented in the classical work "The Evolution of Cooperation" of Axelrod (1984). TFT is probably the most popular and most quoted strategy in the game-theory literature. TFT is a strategy where player two with servile obedience follows the latest moves of player one. If player one defects, player two follows with defection in order to adapt to the prevalent behaviour of the game (Outkin, 2002).

TFT is not successful if the discount parameter[3] (W) of the potential decision is not large enough. For instance there is no point of defecting if collaboration leads to small incremental benefits or if the risk is higher than the potential payoff in the short run.

> *"TIT FOR TAT's robust success is its combination of being nice, retaliatory, forgiving and clear. Its niceness prevents it from getting into unnecessary trouble. Its retaliation discourages the other side from persisting whenever*

[2] *"What is the best strategy? What strategy will yield the highest score?"* (Axelrod, 1984, p. 14).

[3] The discount parameter is a useful tool to subdivide the total value of the decisions. For instance, the weigh of the second decision could be half as important as the first, and the third half as important as the second. In this case, if using a discount parameter, it would be 1. The chain expressed in cumulative terms would give $1+w+w^2+ w^3+\ldots w^n$ (Axelrod, 1984; Hörte, 2002).

defection is tried. Its forgiveness helps restore mutual cooperation. And its clarity makes it intelligible to the other player, thereby eliciting long-term cooperation." (Axelrod, 1984, p. 54)

3.3 STRATEGIES RELATED TO TIT FOR TAT

Axelrod (1984) enumerates a number of different strategies related to Tit for Tat, such as (1) Following the other player's move, but turning back to the collaboration position as soon as an own defection takes place, or (2) Tit for Two Tat (TFTT) which is a strategy where the counterpart needs to defect two times before you follow the behaviour. (Axelrod, 1984)

3.4 MUTANT STRATEGY (MS)

A powerful strategy can be MS, where the player is exploring different ways of finding high payoffs through trial and error (Axelrod, 1984). This strategy represents a risky way of finding a solution to the decision; but in it self also increasing chances to get high payoffs. In the end of repeated games, the behaviour of MS players are recognized by defection. Defection in last game will be called the "mutant strategy seeker" (MSs) - see the upcoming figure 1.

3.5 START UP STRATEGY (SUS)

In new situations when one player is totally unaware of the other player's behaviour it could be extremely important to have a well developed strategy. One possible position could be starting games with defects and then following the rules of the other player (Axelrod, 1984). SUS strategy is especially successful in order to lubricate drowsy relations.

3.6 STRATEGY IN FAMILIAR ENVIRONMENT (SFE)

Ethnic and cultural mechanisms may influence strategy. SFE is represented in contexts of established relations, such as cultural ties between the players (Axelrod, 1997; Jones and Wicks, 1999; Adler, 2001; Sally, 2001). Avoiding defection is appropriate or even necessary in certain cultures (i.e. in your own neighbourhood). Consequences of defection may cost you in terms of a quick downside of your own reputation or result in deeds where a dominant player actively works to limit your own chances (Axelrod, 1984).

3.7 ZERO SUM GAMES AND MUTUAL COLLABORATION (MC)

In zero sum games, survival is becoming more central than the amount of the payoff. The pay-off is not accounted for in terms of how well, how much, or how big potential you may win. Instead success is just accounted for in terms of survival. The best example is probably war, where you either survive or kill your enemy, overkill will just cost extra energy (Axelrod, 1984).

The "live and let live strategy" offer high payoffs in the short run (i.e. one can stay alive). At the same time such a strategy limits the possibilities of high payoffs in the long run, unless one formally contracts and protects the agreed wills. A crucial question remains: When will a player abandon the higher short-run payoffs for sustainable survival? The answer is partly related to altruism and live and let live strategy (Outkin, 2002).

4. RESULTS

Following section describes two different games. The first contains a simple non-iterated game. The second illustrates a repeated game. The underlying assumptions for both the simple and the iterated games will be the same as already declared in matrix 1. The consequences and all possible outcomes of both games can be seen in figure 1.

4.1 THE SIMULTANEOUS ITERATED GAME

The assumptions clarified above (in the simple game) will also be used as terms of trade for the iterated game. Figure 1, below, views all possible outcomes of these two games. It is common to illustrate sequential games with a time aspect in tree illustrations. This game has excluded the time aspect, which means that player two is not aware of the choice of player one in each game. However both players are presumed to act independently of the other player's previous move.

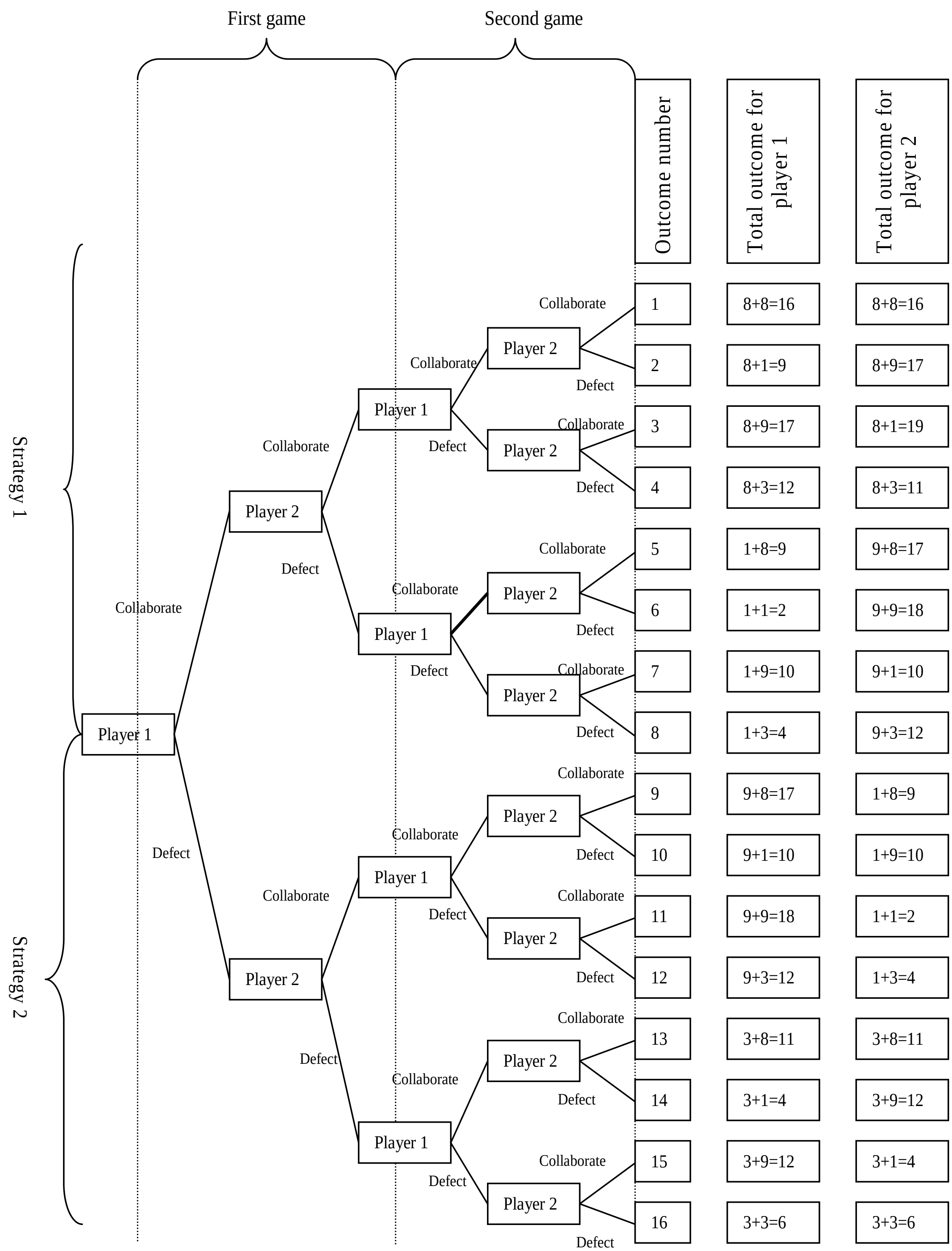

FIGURE 1: AN ILLUSTRATION OF DERIVED OUTCOMES

Tree diagrams illustrate, as in this case, paths to the value of total decisions. Illustrations thus bridge awareness and history of alternative decision-making for managers who actually are about to plan or make a significant decision. The figure also views every possible total outcome appreciated in an outcome box on the right hand side. The game does not consider a situation with a discount parameter (W), hence every decision posses w=1.

5. ANALYZING THE RESULTS

The results are to be analyzed in following way. First a proposed analysis is conducted for the simple simultaneous game. This will be divided into four different mathematical analyzing methods. The mathematical methods will be expressed briefly and finally the outcomes of every analytical tool will be expressed in the outcome matrix (see Table 2). Again, outcomes are based on assumptions from matrix 1. Secondly the simultaneous iterated game will be analyzed. The analyses of the iterated game are based on the basic assumptions in matrix 1 – the results of both games are possible to view in figure 1. The analyses for the iterated game will be conducted with the same mathematical principles and be followed up with parallel analyses against common strategies in the game theory literature, table 4 & 4 This enables analytical generalizations about the results in this game.

5.1 ANALYZING THE SIMPLE SIMULTANEOUS GAME

As the PD in matrix 1 reveals, each player has two main decision options: collaboration or non-collaboration. In order to achieve simple analysis of the material, some general models from Grubbström (1997) will be applied. The analysis could in a managerial situation work as penetrating different ideas. If for instance a board of directors discuss whether they should collaborate or not, two main issues appear: The first issue concern expected behaviour from the counterpart. Different behaviours are already constructed in the theory section and will now be analyzed. The second issue is from what perspective should these behaviours be analyzed. In order to visualize different perspectives systematically, the strategic team or manager may want to approach the expected behaviour from different perspectives. The upcoming mathematical methods represent different views (pessimistic, optimistic, a summarizing and weight estimation of the outcomes). Understanding the outcomes may best be explained by the following table.

TABLE 1: UNDERSTANDING THE OUTCOMES (Developed from Grubbström, 1977)

	Wald's pessimistic perspective	Hurwitz' optimistic perspective	β_1	β_2	·	β n	Weight criterion
$^{\alpha}1$	$\hat{u}_1$	$\bar{u}_1$	$^{u}11$	$^{u}11$	·	$^{u}1n$	$\gamma\bar{u}_1+(1-\gamma)\hat{u}_1$
$^{\alpha}2$	$\hat{u}_2$	$\bar{u}_2$	$^{u}21$	$^{u}11$		$^{u}1n$	$\gamma\bar{u}_2=(1-\gamma)\hat{u}_2$
.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.
$^{\alpha}m$	$\hat{u}_m$	$\bar{u}_m$	$^{u}m1$	$^{u}m2$	·	$^{u}m1$	$\gamma\bar{u}_m=(1-\gamma)\hat{u}_m$

5.1.1 WALD'S CRITERION – THE PESSIMISTIC VIEW

The first method utilized here is Wald's criterion, which aims at exploring the outcomes from a pessimistic perspective. The pessimistic decision-maker is risk avert and searchs for minimizing the risks. If a board of directors hence know the counterpart is active in, for instance, a mature industry, companies tend to minimize the risks at the margin and instead focus on producing high volumes. The mature industry will hence in the sequential independent decision moment be devoted to minimize the risk, given any consideration on long-term benefits. Hence, given the data in matrix 1, the decision maker selects the highest of the lowest values in every row (maximin).

$$\hat{u}_i = \min_j u_{ij}$$

In order to avoid the player from the worst outcomes, the player with a Wald criterion will chose alternative α_i which maximizes $\hat{u}_i$ (see table 1). In this sense the player is using Wald's criterion (Grubbström, 1977).

5.1.1 LAPLACE'S CRITERION – AVERAGE VIEW

The first method utilized here is Laplace's criterion is applicable in situations where there are no specific probabilities and, in other words, every strategy is equal as a potential alternative. This criterion gives a vivid picture of the different outcome values and hence visualizes the strategic discussion.

$$\sum_{j=1}^{n} q_j u_{ij} = 1/n \sum_{j=1}^{n} u_{ij}$$

Assume then the proportions of all β_j are the same, in other terms $q_j = 1/n$ where (n)is the number of player and (j) is the start value. To evaluate the results, Bayes' criterion will be applied. This is the same as maximizing the sum of the rows in the outcome matrix (Grubbström, 1977).

5.1.2 HURWICZ' CRITERION – THE POSITIVISTIC VIEW

The second tool, Hurwicz' criterion, mainly focuses on the best outcomes. If a decision-maker faces a situation where his/her counterpart is presumed as a high-risk entrepreneur, we may expect a more opportunistic behaviour. Following the logic of

$$\bar{u}_i = \max_j u_{ij}$$

this player would concentrate on the best outcomes. If α_i which maximizes the $\bar{u}_{ij}$ a maximax solution is thus the natural choice. (Grubbström, 1977).

5.1.4 A WEIGHT CRITERION – A WEIGHT AVERAGE VIEW

The fourth method presented is a weight criterion, which simply estimates an average using a weight. We estimate the weigh (γ) to 0,8, but also test it to 0,2 which will increase significance of a more careful player.

$$\gamma \bar{u}_i = (1 - \gamma)\, \hat{u}_i = \gamma \max_j \bar{u}_{ij} + (1 - \gamma) \min_j \bar{u}_{ij}$$

A person who is neither pessimistic nor optimistic would try to estimate a weight average of $\hat{u}_i$ and $\bar{u}_{ij}$ and with this guidance maximize this value. If γ is the weight which $\bar{u}_i$ receives and $(1 - \gamma)$ the weight which $\hat{u}_i$ receives, this person is maximizing his/her value (Grubbström, 1977).

5.1.5 THE OUTCOME MATRIX

TABLE 2: THE OUTCOME MATRIX

	Lowest score ($\hat{u}_i$) Wald's criterion	**Highest score ($\hat{u}_i$) Hurwicz' criterion**	**(∑) Sum of the row**	**γ=0,8 Weight average ($\gamma \bar{u}_i + (1 - \gamma)\, \hat{u}_i$)**	**γ=0,2 Weight average ($\gamma \bar{u}_i + (1 - \gamma)\, \hat{u}_i$)**
Collaborate	1[1]	8[1]	9	6,6	2,4
Not collaboration	3[1]	9[1]	12	7,8	4,2

- Regarding the minimizing strategy, Wald criterion, the player will chose the highest of the low values, which in this simple game ~~it~~ means not to collaborate.
- Regarding the maximizing strategy, Hurwicz criterion, implicate that the player chooses the value which yields the highest score. In sense of this perspective he/she should not collaborate.
- Regarding the summing up strategy, Laplace's criterion, the player chooses the highest of the high scores in the added row. Non-collaboration is here the most successful strategy.
- Regarding the weight criterion, the player chose the value which yields the highest value. Both weights γ=0,8 and γ=0,2 suggest that the player should not collaborate.

5.2 ANALYZING THE RESULTS IN THE ITERATED GAME

TABLE 3: AGGREGATED VIEW – ANALYSIS AND PROPOSED STRATEGIES TO EACH OUTCOME

	Game 1		Game2		Strategy referred to section 3.2		Commentary of to be followed up more detailed
Outcome number	**Pl 1**	**Pl 2**	**Pl 1**	**Pl 2**	**Kind of strategy pl 1**	**Kind of strategy Pl 2**	
1	8	8	8	8	Collaboration	Collaboration	Total scores of collaboration
2	8	8	1	9	SFE / TFTT	MS	SFE/TFTT/MS
3	8	8	9	1	MS	SFE/ TFTT	MS/SFE/TFTT
4	8	8	3	3	MSs	MSs	MSs
5	1	9	8	8	MS / SUS	MS/SFE/SUS	MS/SFE
6	1	9	1	9	TFTT/ SFE	MSs	Highest and lowest possible theoretical pay-offs
7	1	9	9	1	TFT	TFT/SUS	Both players following typically TFT strategies
8	1	9	3	3	TFT	ND	TFT/ND
9	9	1	8	8	MS/ SFE/SUS	SFE	MS/SFE/SUS
10	9	1	1	9	TFT/SUS	TFT	Both players following typically TFT strategies
11	9	1	9	1	MS/MSs	SFE/ TFTT	Highest and lowest possible theoretical pay-offs – MS/MSs/SFE/TFTT
12	9	1	3	3	ND/MSs	TFT	MSs/TFT
13	3	3	8	8	TFT	TFT	TFT
14	3	3	1	9	MS/ TFT	MS/TFT/ND	TFT/ND
15	3	3	9	1	ND	SFE	
16	3	3	3	3	Notorious defectors	Notorious defectors	Both player notorious defectors (ND)

The analyses from the repeated game are based on the scores expressed in matrix 1 and figure 1. The analyses of the repeated game reveal a specific kind of pattern in behaviour and thus manifest the strategy the player uses. Hence each outcome also represents decision behaviour, derived from figure 1 and further analyzed as an abbreviated strategy in table 3 and 4. The abbreviations are respectively discussed in section 3.1-3.7.

First of all there are as many options to collaborate as there are to defect. It is for example clear that an aggregated view could be employed if every collaborative number was summed up and compared to the total sum of all defections (see total score - Table 3). In the commentary column (Table 3), every strategy is labelled and will facilitate more elaborate analyses (see upcoming Table 4 where each score is compared to strategies based on the theoretic field).

What will then be the choice of the rational player? To approach this question, I will conduct the same mathematical analyses as in the simple game (see Table 4 below).

TABLE 4: ANALYSIS OF PROPOSED STRATEGIES IN THE ITERATED GAME

	These three columns will select the two lowest and two highest values related to each strategy.				Lowest total score - Wald criterion	Highest score - Hurwicz' criterion	Sum of the row	Weight average 0,8	Weight average 0,2	Average of the both weight criterion results
	MIN		MAX							
Collaboration and survival	16	16	16	16	16	16	64	16	16	16
Tit for Tat (TFT)	4	4	11	12	4	12	31	10,4	5,6	8
Tit for Two Tat (TFTT)	2	2	9	9	2	9	22	7,6	3,4	5,5
Notorious defector (ND)	6	6	12	12	6	12	36	10,8	7,2	9
Mutant strategy (MS)	4	9	17	18	4	18	48	15,2	6,8	11
Mutant strategy seeker (MSs)	11	12	18	18	11	18	59	16,6	12,4	14,5
Strategy in familiar environment (SFE)	2	4	17	17	2	17	40	14	5	9,5
Start up Strategy (SUS)	9	10	17	17	9	17	53	15,4	10,6	13

The analyses of the results conducted in table **4** are as follows:

- According to Wald's criterion, a careful player chooses the maximum of the minimum – in this case a collaborative strategy.
- Employing Hurwicz' criterion when searching for the highest possible score, a MS or MSs strategy is suggested.
- Referring to Laplace´s criterion – which sums up the scores and then selects the highest – a collaboration strategy is most suitable
- A weight criterion with **γ=0,8** suggests a MSs strategy.
- A weight criterion with **γ=0,2** will suggests a collaborative strategy.
- Finally, an average of the both weight criteria will indicate a collaborative strategy.

The analyses will be concluded below. Since the scores are appreciated in detail and are following the results, the analyses will be directly followed by conclusions which will be presented consecutively in the upcoming section of the paper.

6 CONCLUDING REMARKS AND DISCUSSION

In the concluding remarks some of the analyses will be discussed and compared to the theoretical base. Regarding the game we see that there is no dominant[4] strategy. The results instead indicate that there is a base for collaboration between the two actors in just one simple game.

[4] A dominant strategy is the one which outperforms all other strategies (Zagare, 1984).

Collaboration would most likely appear when both companies are aware of how an intended decision will affect the outcome. To reduce uncertainty, the results indicate that collaboration will benefit from formal agreements or from being based on a collaborative strategy.

According to Axelrod (1984) a TFT strategy is the most successful strategy, despite the fact that my example (except from one case) depicts the collaborative strategy as most successful. However, given a risky player or a player controlling and forecasting the length of the game, a TFT strategy could possibly beat a collaborative strategy and take advantage of the SFE strategy player through a MS strategy. Note also that a player applying a SFE strategy will be "raped" business ethically if he/she meets a ND, MS or MSs player. The results also indicate that iterated games with a high weight (γ =0,8) on the high scores, i.e. a risky strategy, can pay off much more than a low-risk strategy. This is also consistent with theories, emphasizing that a risky trial and error strategy (MS and MSs) might give high pay-offs, especially if the player is aware of the length of the game and takes advantage of this (Axelrod, 1984).

There are widely cited evidence and arguments that trust emerges in successful iterated activities (Sarbin, 1994; Mayer, Davis, and Schoorman, 1995; Jones and Wicks, 1999). Benefits of trust are indeed important and in practice probably a bottom-line prerequisite for any interfirm relation to emerge. As this paper indicates, trust also needs to be planned and bounded to a mutually agreed understanding; otherwise it opens for penalties and/or undesired exploitation. Adler (2001) argues that routines could be managed by hierarchies, but that more complex situations should be managed by communities which include interfirm relations. This paper emphasizes that functional cooperation could be worked out from collaborative incentives and on the basis of trust. The time perspective obviously also has impact on the situation, since trustbuilding involves mutual learning and building confidence over time. Trust-building enabling competitive advantage also seems to benefit from cultural and spatial closeness. To build trustful relations, often initiated by initial formal agreements, thus may be regarded as a favourable route for players (individuals, companies, or regions) seeking sustainable a competitive advantage, and as strategy to control for short-termed opportunism where a few strong players take advantage of less rational players.

Finally I will conclude with a discussion on Game-theory as a technique and suggestions for further studies. The basic assumption of the game in this paper was derived from Axelrod (1984), where a situation of evolution based on Prisoners Dilemma followed the understanding that R> (T+S)/2. The results were analyzed utilizing four different analyse methods suggested by Grubbström (1977). A contribution of this paper is that it indicates how both practitioners and researchers could use simple methods to understand a strategic-choice situation better. Simple mathematical tools could be used to clarify rules, conditions and terms characterizing different situations. In other words, practical strategic decision-makers may benefit from using game-theory as an argument and justification for formal agreements.

Complex situations surrounding individual decision-making might limit the opportunities to be rational (Romp, 1997). However, game-theory extends the opportunity to manage the complexity and enables every individual actor to be more aware of the consequences of the action they intend to take. Since increasing complexity is fostering collaboration (Kirchkamp, 2000), tools specifically designed to simulate outcomes of alternative decisions to collaborate/not collaborate should be higly relevant. It should be noted, however, that "no chain is stronger than its weakest link" – in this case that the value and usefulness of game-theoretic modelling rely on the assumptions made when modelling different decision-making situations. If one assumption is changed, then the whole game will be changed. Game theory offers a model to map alterative decision-making, but also adds the unique quality of also mapping the action of existing or potential collaborative partners. A challange for future research in the field is to utilize more advanced tools such as programming algorithms, and therby be able to address more advanced and complex decision-making situations.

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