Game of change;
A game theoretic approach to organizational change management

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A game theoretic approach to organizational change management

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Abstract:

Organizational change and game theory were separately investigated over time. Due to lack of scientific research on the relationships of those two fields of knowledge, an investigation of the game theoretic applications in managing change was performed in this research. Game theoretic applications were structured concerning the analytical use of game theory, strategic formulation with game theory and equilibrium analysis. By a qualitative flexible research method, main problematic areas of organizational change were identified with suitable game theoretic applications. Those problem areas are: making cooperation and coalition in change, group dynamic difficulties and the problem of incentive rewards. In each problem area, game theoretic solutions were discussed to help managers to make better decisions. Four mechanisms were inferred to support the game theoretic analysis of change management problems. Those mechanisms are: sub games, practical games, specific modeling and behavioral studies of games. Finally, an instructional framework was developed to conclude findings and illuminate the game theoretic approach in organizational change.
Summary:

Highly competitive situations and fast environmental changes requires effective change management theories. Organizations are looking for change strategies that help them to implement new change plans. Technological improvements and economical changes are affecting organizations so; they have to adapt themselves by useful change strategies. Except for external pressures, organizations want to improve their internal effectiveness and efficiency which also reflect the necessity of suitable change management abilities.

Managing change is a complex and difficult task. It is because of the complexity of all human centered concepts. Change management has an important role because it depends on effective strategies in interdependent and interactive situations. According to the need for efficient decision making under interactive situations among human agents, game theory could be a fruitful source of knowledge and provide understanding of social situations involving two or more players (change agents here) in which the interests are interconnected and players have partial impact on outcome. Therefore, this thesis aims at investigating game theoretic applications in organizational change.

The methodology used in this research is based on an interpretive flexible research design. Contextual analysis was done to answer why game theory can be applied in organizational change. Literature review of organizational change and game theory was done to provide the theoretical framework of organizational change and game theory. Main categories of game theoretic applications were introduced, being analytical applications of game theory, the use of game theory in strategic formulation and making abstract advice and equilibrium analysis of problems. Main problematic areas that game theory can provide solutions are: problems in making cooperation and coalition, group dynamic difficulties in change and the problem of incentive rewards. Each problem area was presented with proper game theoretic solutions and with practical examples in organizational change in order to help managers to make better decisions. Applications of game theory and the identified problematic areas of organizational change were finally structured in a framework. Game theoretic mechanisms of doing the analysis were structured in the framework as sub games, practical games, specific modeling and behavioral game theory.

Criticisms and limitations of game theoretic applications in change management are also addressed to validate outcomes. Issues about rationality of humans, difficulty of use, testability of results and over simplification problem are discussed. According to results and limitations, the main conclusion of thesis is, game theory can be a part of management tool box not whole of that. The best way of using game theory is to start with the game theoretic analysis and equilibrium reasoning and then think about the ways that results may differ from what game theory suggests.

Keywords: organizational change management, game theory, decision making
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1. Chapter one: Introduction

1.1. Background

Change always exists in society and organizations. Financial growth, globalization, mergers and acquisitions, new technologies, re-structuring, decentralization, centralization, total quality management and cultural renewal projects are just examples from the list of changes that organizations face (Mcallaster, 2004). The motives for change will be even stronger in the future. As a result, there will be more pressure on managers to be more global, improve quality, minimize costs, promote efficiency and develop new product and service with increase in shareholders’ wealth (Kotter, 1996). The key inhibitor in all successful improvements is the effectively managing change. An overview of practical experiences reveals that a suitable goal definition is not merely enough, the reason why some organizations are successful is the way they implement those goals.

In spite of the wide variety of change theories that still is expanding; the practice of change is problematic (Andrews et al, 2008). Scholars believe that managing change is a difficult and complex task (Loven, 1999). Therefore, the leading of successful change is not as simple as doing what theories suggest in prescriptive manner. The complexity of managing change refers to the role of human agency in organizations. The role of human agency implies the complex interactions that occur among different change agents within an organization (Caldwell, 2003). Notwithstanding how we define change agents, they reflect social compositions that have conflicts of interests and different value agendas (Pettigrew and Whipp, 1991). The natural conflicts and commonalities of interests among change agents are the reasons why many authors now agree that organizations are essentially political entities (Butcher and Atkinson, 2001). The political atmosphere of organizations reflects the need to understand how to coordinate different benefits of people within the organizational change. Hence, many scholars have tried to define the social groups which are the sources of power in the political environment of organizations but there is less work on how to manage change in that political context (Oakes et al, 1998).

With regard to the emerging political atmosphere, empirical research on managing change illustrates that the “payoff” is one of the effective factors on the behavior of change agents (Mcallaster, 2004). Some authors believe that “change the outcomes people expect and you will change their behavior” (Latham, 2003). It seems that there is a clear motivation to work on theories and to develop models that help to lead organizational change towards compromised solutions that respect people’s expectations.

Based on the need for efficient decision making during interactive situations among human agents, game theory could be a fruitful source of knowledge and ideas.
about social situations involving two or more players in which the interests are interconnected and players have partial impact on outcome (Colman, 1999). The ability of game theory in formal and structured analysis of cooperation and conflict encouraged this research to investigate its applicability in managing organizational change.

1.2. Purpose and aims

The main aim of this thesis is thus to investigate "if organizational change problems can be solved by game theory?" It reflects that this research wants to focus on better managing change by the utilization of game theory. In order to achieve the main aim of thesis, two corollary questions immediately arise:

- Why is the context of organizational change suitable for the game theoretic analysis?
- What are the possible and meaningful applications of game theory in managing change?

The investigation of the nature of organizational change and its characteristics is done in the theoretical part to discover the possibility of game theoretic analysis. Moreover, an overview on the past line of game theoretic applications in other fields of knowledge and the analysis of fundamental definitions of game theory are required to make a linkage between game theory and organizational change.

1.3. Scope of thesis and delimits

The theoretical backgrounds of change management and game theory both have been addressed with respect to focus on the defined problems and game theory applications. Many parts of game theory that are far from change management have not been mentioned and instead, necessary foundations to do the game theoretic modeling have been included. In addition, the theoretical background of organizational change which involves the main divisions of change, managing change and the political atmosphere of organizations that are helpful to understand the nature of organizational change, is represented.

This research is not about any specific case of change. It does not contain the analysis of one specific problem. In fact, it aims at representation of the possible and meaningful game theoretic applications in the organizational change difficulties not deeply modeling of one problem.

In order to keep the managerial perspective in this research, the complex mathematic reasoning has been omitted and instead, inferred lessons are expressed. However, the change situations that require moderate mathematic knowledge have been represented in detail with calculations because it helps to understand the nature of mathematical game theory. Nowadays, many complex games are solvable by
computers, so it is not necessary to show all formulas but essential to know the logic and language of the game theoretic modeling.

### 1.4. Outline

The thesis is structured to achieve its objectives through the six chapters that described below:

**Chapter 1:** The first chapter aims to describe problem that motivated this research as well as the purpose and aims of thesis, scope of research and relevant delimits.

**Chapter 2:** It explains the methodology that was adapted in this research with explanation of approaches to create credibility and verified research project.

**Chapter 3:** This chapter has a comprehensive overview of necessary theoretical foundations of organizational change that are ultimately being used in the analysis. It covers the main divisions, definitions and difficulties of organizational change.

**Chapter 4:** this chapter aims at expressing the necessary definition, divisions and solutions of game theory and game theoretic modeling. The past line of applied games and the behavioral game theory is also discussed to help to understand the social situations that game theory can be applied in them.

**Chapter 5:** The game theoretic applications in organizational change are presented in this chapter. It is structured in a way that represents the possible solutions of game theory in three categories of organizational change problems. Those problems have been concluded through the synthesis of theoretical backgrounds of organizational change and game theory. The applications of game theory have also been categorized in three clusters that were presented in chapter 4. An instructive framework was also proposed in this chapter to represent how generally game theory can be used in organizational change and by which methods

**Chapter 6:** Discussions and limitations of game theoretic applications have been addressed during this chapter. They explain the main problematic issues about applied games and the necessary assumptions that should not be neglected. Based on the results and limitations of applying game theory in organizational change, the conclusion of thesis was also discussed at chapter 6.
2. Chapter two: Research methodology

Research is actually perceived as one of the fundamental aspects of life. It refers to the mission of research in any kind to develop knowledge and to achieve better understanding. The definition of a research project helps to understand what should be done in a research and how; "For the social scientist or researcher in applied fields, research is a process of trying to gain better understanding of human interactions. Through systematic means, the researcher gathers information about actions and interactions, reflects on their meaning, arrives at and evaluates conclusions, and eventually puts forward an interpretation" (Marshall and Rossman, 1995). In this chapter, the most effective research method in relation to the topic of thesis is presented. The motivations behind the selection of research method are also discussed.

According to what literature express about a research project, the process of research is determinant in the way to achieve goals. In fact, the research project is a systematic way of taking some steps to utilize theoretical foundations into analysis and making conclusions (Leedy and Omrod, 2001). In this research project, the applicability of game theory in managing organizational change was investigated. According to the primary literature review, it is assumed that there is a relation between game theory and organizational change. The indentified lack of an integrated research that incorporates both fields motivated this work.

Obviously, this research deals with successively increasing theoretical information in each step of the research process. Inherent ambiguities in the research process as well as the content of the information have guided to select a qualitative and interpretive research process that was based on a flexible design. "Interpretivist researchers regard their research task as coming to understand how the various participants in a social setting construct the world around them" (Glense and Peshkin 1992)

The flexible research process is less linear because research starts with the topic of interest and a primary literature review but the analysis may reveal some information that the researcher wants to take into account and incorporate as a new perspective. The flexible design means to apply "iterative" approach where the researcher may want to step back when it seems desired. This research design is suitable for the aim of this thesis because the analysis may unfold new knowledge about the thesis direction, theoretical framework or even the research question(s).
2.1. **Description of the research process**

As Figure 1 illustrates, regardless of the research process of any kind, each research project comes with a topic of interest. The importance of a successful organizational change and the nature of organizations that reflects the commonality and conflict of interests created the main idea towards a game theoretic approach within the organizational change. A general overview on literature has been done to gain more concrete idea about the topic. That primary overview tended to ask “How can organizational change problems be solved by game theory?” Two corollary questions were inferred from the main question: Why the context of organizational change is suitable for game theoretic analysis? And what are the possible applications of game theory in change management?
A comprehensive literature review has been done to reach the necessary theoretical framework. Theoretical framework is important to lead better analysis because, "It informs the research process and helps to direct it" (Williamson, 2000). The lack of research about the integration of these two fields compelled separated literature reviews on game theory and change management. It was tried to give an overview on theories that are close to the topic of the thesis. Therefore, the theoretical foundations that satisfy the managerial perspective of the thesis are presented. However, the selected theories are more practically underpin the managerial implications. As a result, theories that are far from the practice of change were excluded. As a result, change management literature was reviewed with the underlying approach of being practical or helps the game theoretic analysis. There is a wide variety of theories in managing change that sometimes contrasted each other, hence, the more practical divisions, definitions and difficulties of managing change were selected to present. Suggested follow ups from different scholars, the concept of modeling change, dimensions of change and the nature of organizations as political entities with a brief review on the role of culture in managing change have been expressed.

In the theoretical background of game theory, the main concept of equilibrium, equilibrium analysis (solutions), past line of applied games, useful divisions of game theory and reasoning methods are explained. They create the necessary foundations to understand models and solutions that are later introduced in the analysis. Literature review sources include books, scientific articles, some instructive movies and lectures. In order to accomplish a reliable investigation, it was decided to make comparison with different fields of application where game theory has been used. Economy, policy, sociology, biology and strategic management are those fields that complement each other in the analysis and make conclusions more reliable.

While analyzing the possible applications of game theory, it was concluded that there is a clear lack of knowledge about the behavioral aspects of games. Organizational change deals with human agencies that are not subject to pure rational players. It led to perform another theoretical review about the behavioral game theory to cover irrational issues of human behaviors. This helps to generalize results and to achieve more managerial insights.

Based on theoretical background, three problem domains were inferred to be analyzed by game theory. These problematic areas have been presented during the chapter 5. The reasons behind why those problems are important in managing change have also been discussed during each section about the specific problem. Those problem domains and their related motivations were extracted from the literature. In order to make the thesis easier for reader, it was decided to explain those difficulties during the chapter five with their relevant solutions rather in theoretical background.
In order to perform the game theoretic analysis for each problem area and give solutions, some game theoretic mechanisms were used. Those mechanisms are not independent methods but support each other and were inferred from the theoretical background and were represented in chapter five before the analysis of problems. Those mechanisms are in fact the instrumental core of the analysis that is based on the fundamental theories of games that discussed in chapter 4. They are not new theories but methods that anchored by the basic theories of games. Finally, a general framework was proposed to illuminate the game theoretic approach in organizational change. The proposed framework concludes the analysis and results of this thesis while help researchers in future efforts towards the game theoretic applications in organizational change.

In chapter six, the criticisms and discussions about the applications of game theory were discussed and the conclusion of findings was expressed. The findings of the thesis were discussed during the research process with the supervisor and some managers from private and public organizations to gain explicit and implicit knowledge. The results of these discussions had an impact on the re-structuring of the analysis and the introduced applications.
3. Chapter three: Theoretical background of organizational change

Organizational change has become an important issue in the last 50 years. Accordingly, managing change has an important role in each successful change process. In this chapter, an overview of the theories that support the topic of thesis is presented. As described in the methodology in chapter 2, change management theories that are more practically oriented along with the useful divisions and definitions of organizational change are addressed.

3.1. Planned and unplanned change

Considering the necessity of organizational change, scholars have suggested varied perspectives and typologies on change. It seems that this area is expanding and involves some contradictory theories that each one focuses on one aspect of change. Therefore, a primary distinction among theories of organizational change could be a categorization that is based on planned and unplanned change. In planned change, an organization transforms from point A to point B and the transformation is deliberate to improve functionality of the organization. On the other hand, the unplanned change is generally a change of evolutionary, accidental or spontaneous (Poole and Van de Ven, 2004).

The main distinctive characteristics between planned and unplanned change is the role of human agency in change. Planned change is often driven by actors whereas unplanned change may or may not be driven by human agency (Poole and Van de Ven, 2004). Theories of planned change talk about how change can be effectively managed and accomplished while the theories of unplanned change emphasize the forces of change (Kezar, 2001). Although it seems that planned and unplanned changes have different worlds of theories, it is important to know their relation and the inseparable conceptual integration. Each planned change occurs in the context of unplanned change; hence, in order to have an effective process of managing change, the analysis of unplanned change is unavoidable. Managers can channel or at least consider unplanned change in order to lead planned change in a more effective manner.

Following the discourse about planned and unplanned change, Van de Ven and Poole (2004) defined four basic motors of change. As Figure 2 illustrates, each of these motors is like a mechanism to bring change. They are fundamentally different in terms of the progression and the generative causes to change. These four generative motors are not independent because a combination of those theoretical motors often is present. Hence, it is possible to see two or more change motors together in one specific change process.
3.2. Rhythm of change

In addition to the four basic motors of change, there are other aspects concerning change processes. Change can be episodic or continuous. Some researchers define the episodic change as infrequent and discontinuous while the continuous change is evolving (Poole and Van de Ven, 2004). The rhythm of change categorizes the theories of organizational change because it creates different patterns to perceive and manage organizational change in terms of human agency, change objectives and the time. The rhythms of change are not contradictory rather more complementary. The characteristics of episodic and continuous change were also represented in Error!

Reference source not found. by Weik and Quinn (1999). The comparison between what Weick and Quinn (1999) say and what Poole and Van de Ven (2004) proposed as four motors of change illustrates that there are large similarities between them. They both have separations into continuous development and episodic process. However, they have also different perspectives about linear and cyclical patterns (Karltun, 2007).
Table 1: Comparison of episodic and continues change. Redrawn from Weick and Quinn (1999)

<table>
<thead>
<tr>
<th>Metaphor of organization</th>
<th>Episodic change</th>
<th>Continues change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change is an occasional interruption or divergence from equilibrium. It tends to be dramatic and it is driven externally, it is seen as a failure of the organization to adapt its deep structure to a changing environment.</td>
<td>Change is a redirection of what is already under way. Change is Confucian: cyclical, processional, without end state, equilibrium seeking, eternal. 1. Freeze: make sequences visible and show patterns through maps, schemas and stories. 2. Rebalance: reinterpret, relabel, resquence the patterns to reduce blocks. Use logic of attraction. 3. Unfreeze: resume improvisation, translation, and learning in ways that are more mindful.</td>
<td></td>
</tr>
<tr>
<td>The necessary change is created by intention. Change is Lewinian: inertial, linear, progressive, global seeking, motivated by disequilibrium and requires outsider intervention. 1. Disconfirmation of expectations, learning anxiety, provision of psychological safety. 2. Transition: cognitive restructuring, semantic redefinition, conceptual enlargement, new standards of judgment. 3. Refreeze: create supportive social norms, make change congruent with personality.</td>
<td>The ideal organization is capable of continues adaptation.</td>
<td></td>
</tr>
</tbody>
</table>

3.3. Modeling change

Models are representations of theories in a formal language like the mathematical or computational algorithms. A model uses the verbal theory and observations in order to project how a process occur and how can be managed. Figure 3 describes the relations between theory, data and the model. Models help to analyze and anticipate the behaviors (Leik and Meeker, 1975). Models are often more specific than theories because they built on the specific assumptions of a theory. The usefulness of a model is because it is deriving implications from the theory that cannot be elicited from the verbal definition of theory (Poole and Van de Ven, 2004). The inherent complexity has persuaded many scholars to create models like the Dynamic models to represent variables that affecting a theory and their key features (Sterman, 2000). Those dynamic models explain how it is possible to model variables and their related cause and effects. The relational loops in dynamic models help to understand the outcome of a system as whole (Sterman, 2000). The self organizing system models to find how a
system moves from its equilibrium and the complex adaptive system models to represent how the agents act and react with themselves and their environment are such examples of modeling change (Poole and Van de Ven, 2004). Models also have their limitations like the over simplification problem, their rigidness and the lack of enough flexibility. The theory-model-data triangle in Figure 3 that proposed by Leik and Meeker (1975) represents the relation between them:

Inductive modes:
A-mathematical generalization  
B-substantive interpretation of mathematical patterns  
C-Mathematical generalization of empirical patterns  
d- Substantive interpretation of data  
Deductive modes:  
E-formalization of theory  
F-derivation of substantive hypotheses from mathematical patterns  
G-mathematical prediction or extrapolation  
H-substantive prediction

![Figure 3: The relation between Theory, data and model. (Leik and Meeker, 1975)](image)

3.4. Change dimensions

Each change theory can be defined in relation to the role of human agency, time, and the level of analysis that theory wants to focus on (Poole and Van de Ven, 2004). The theories about organizing and leading change must be clear about these three key factors. They are. Each theory of change uses those key concepts in a specific way. Regarding to the aim of this thesis, I will try to define the relation of game theory with the role of human agency and the level of analysis. The role of time seems not so determinant in game theoretic applications since it just explains the meaning of time in a change process from different perspectives. The theories that are useful for this work and are close to the reasoning line of this research will be explained in detail.

The role of human agency can be very complex when it comes into the interaction of agencies. Some of the theories like those that have been derived from the theory of rational choice have the special simplification to model the agency interactions (Poole and Van de Ven, 2004). The theory of rational choice looks at humans as rational people with economic behavior that are competing for limited resources (Barney et al, 2001). It does not mean that a rational agent has not any intervention of emotions or excitements because the advanced works in theory of rational choice are trying to expand rationality and incorporate the role of history, fairness, altruism, groups and society (Camerer, 1997). Along with the role of human agency, theories of collective action and theories concerning the interactions between human agency and organization want to give the individual agents and the organizations an equal status (Lou et al, 2000). The role of the critical mass as a group of humans that initiate a change is also an example of the theories that are close to the nature of a game.
theoretic approach within the organizational change. The role of critical mass also has been used in the game theoretic modeling to analyze and change the behavior of humans in change process (Dixit and Nalebuff, 2008). More details about different perspectives on the role of critical mass have been discussed in the handbook of change and innovation by Poole and Van de Ven (2004).

The agent based modeling approaches are also trying to model the different agent's interactions. Agents or a group of agents are different in their power, activity and effectiveness. The interactions of those agents ultimately can determine the change outcomes (Henrickson and McKelvey, 2002). However, the agent based modeling has its own limitations. It is weak in terms of the interpretive processes and action meanings.

Organization is a multi level concept. Theories of changing deal with the different levels of human agency. Concerning to level of analysis, there is a useful categorization below: (Dansereau et al, 1999)

- Homogenous groups, where members are merged into a higher single unit.
- Heterogeneous groups, where involve interdependent members.
- Independent units which are dependent and cannot be referenced to group as a whole.

Heterogeneous groups may be composed from the individuals or the subgroups that are interconnected but separable.

### 3.5. Managing change

Some theories of organizational change focus on change per se. They look at change as a scientific phenomenon not as a practical term. This approach is better for researchers because they can have more comprehensive studies on change itself. The practical or managerial issues about change may limit their knowledge and innovation (Poole and Van de Ven, 2004). They define the important factors and processes of change but there might be also a lack of relation with practice. Here, it was tried to present more practical theories of managing change.

The theories of managing change might be difficult to use in practice and control the change. According to the inherent complexity of change, it is useful to notice that managing change is a difficult and complex task (Loven, 1999). Managers should be aware that it is not as simple as implementation of a prescriptive theory to manage a change. Change can go in unexpected directions and a lot of unwanted events may occur during a change. The lack of theories which can lead successful change have persuaded scholars to emphasize this linkage at recent years. There is a clear need to work on implications of theories in practice. As the aim of this thesis is to find implications of game theory in managing change, the efforts should be in a way to reconcile pure theory with the practice.
Managers seek more practical guidelines even when those guidelines are incomplete or rejected by new ones. In managers’ point of view, a good theory is the one which works. There might be a comprehensive theory but nobody knows how to model a real situation by that or how to implement it. Clarity and simplicity are the criteria that managers use to choose an idea and to develop it during the progress. (Beer et al, 1990)

To satisfy the need of managing change, different authors have tried to understand those parts of theory that are useful for managers. It could be possible to say, the key inhibitor into most successful implementations of change theories is the managing of complex interactions that occur among different change agents within the organization. The change process is not a linear process which a hero leader can do it. Different agents have different perspectives and benefits. Some authors divide these change agents into; senior leaders, middle managers, external consultations and teams (Caldwell, 2003).

In addition to motivations to create theories that directly link to practice, there is also important to consider the role of learning methods of those theories for managers. Managers mostly have problems to use techniques in a particular workplace. It implies the lack of understanding the concepts and creativity (Collins, 1998). Another problem is the time. Managers often do not have enough time to reflect on events that occur during a change program (Doyle et al, 2000). In order to have an effective theory learning that can link directly to practice, the focus has to be on the relationship between tacit and explicit knowledge. A four stage plan about the learning process was proposed by Aram and Salipante (2003):

- **Socialization:** where managers exchange tacit knowledge.
- **Combination:** to combine their explicit knowledge with new explicit knowledge.
- **Externalization:** managers make explicit formerly tacit knowledge
- **Internalization:** managers take explicit knowledge and try to digest it by their tacit ways of knowing and practice.

Some authors challenge the organizational change theories and believe that they reflect instrumental motivations. Inherent managerialism in the organizational change theories is one of those concepts which also was criticized (Sturdy and Grey, 2003). They argued that the organizational change theories neglect the power distribution and the conflicts as an inevitable part of reality. These conflicts some times are out of control. Controllability of a change is the subject which is discussed by different researchers who believe that change cannot be controlled. They use the "chaos" metaphor in their attempts (Shaw, 2002). The empirical studies on managing change also reflect the complexity and uncertainty of change processes. The lack of control which is discussed by Shaw (2002) can also be seen in those empirical works like in research by Andrews et al (2008):
"We don’t know what type of structure our directorate will end up looking like yet. It’s still very much in a state of change [. . .] we’re not sure how it will end (Senior Manager)." (Andrews et al, 2008)

Besides what different scholars express about the chaotic nature of organizational change and its complexity, there is a clear need of guidelines to start with. It is remarkable that the substance of a guide line or a strategic frame work is more essential than merely figurative steps of that. The focus on the concept behind a strategic frame work helps to use it in a more flexible manner. Managers, who know the underlying reasons of such schemas, can apply it with modification due to their specific contexts. The role of contextualization is the point that managers have expressed in different empirical studies (Andrews et al, 2008). The rigid focus on the steps of a change plan may tend to neglect the basic requirements of a plan. Kotter (1996) has mentioned different mistakes that make a failure change and proposed an eight stage follow up to bring a successful change. His eight stages process is: (Kotter, 1996)

- **Establishing a sense of urgency**: it includes assessment about competitive reality, identifying and discussing the crisis, potential crisis and major opportunities.
- **Creating the guiding coalition**: it starts with building a group for leading change which has enough power. Group work skills and team work capabilities are required.
- **Developing a vision and strategy**: it comes with creation of a vision to direct change efforts and making a strategic plan to achieve that vision.
- **Communicating the change vision**: it is important to use different communicative tools and techniques to constantly communicate with vision and a role model to define the expected behaviors.
- **Empowering broad-based action**: it comes with getting rid of obstacles, encouraging risk taking and informal ideas and nontraditional actions.
- **Generating the short term wins**: it means planning for visible improvements in performance. Rewarding to whom made those wins are also necessary.
- **Consolidating gains and producing more change**: it refers to increased credibility to change structures, systems and policies that are not fit together. The consolidating stage can be with reenergizing the process with new projects, themes and change agents.
- **Anchoring the new approaches in the culture**: change should be stabilized by articulating the connection between behaviors and organizational success. It also needs leadership skills to ensure development and succession.

Notwithstanding to scientific articles and books about the managing change; there are also attempts by practical experts who are change consultants and have tried to
articulate their experiences into the explicit knowledge. The multidisciplinary works which walk between scientific theories and the world of practice are such useful texts to illuminate how to manage change. They incorporate real examples with scientific background to define how change occurs and what necessary steps must be taken. The downside of these efforts is the lack of versatility. Specific experiences might be much context sensitive. It seems that managers need to work with the more flexible theories which can help them in different situations. A five step approach to change by Latham (2003) is one of those multidisciplinary works that has been presented below: (Latham, 2003)

- **Superordinate the goal**: it is necessary because it captures the hearts and appeals the emotions.
- **Goals setting**: goal setting is about concreting those superordinate goals. It makes it achievable, concrete and connects into an action steps. Goals setting means the breaking a superordinate goal into SMART goals. (Specific, Measurable, Attainable, Relevant and Time frame base)
- **Accessibility**: leaders need to be accessible because people should see them what they are doing and how they are committed to goals.
- **Integrity**: leaders must have commitment to super ordinate and SMART goals. It means that leaders have to be aware about what signals they send. Integrity means that leaders should coordinate all their activities and signals based on their super ordinate and SMART goals.
- **Measurement**: it refers to the fact that "when things are measured, they get done" (Latham, 2003). Leaders must be sure that effective measurement system is associated with the change goals, both super ordinate and SMART ones. The reward and punishment systems should align precisely with the desired change outcome to shape the behaviors.

The comparison between those two strategic follow ups reveals that the main parts of both action plans are the same. Step one in Latham's five steps can be divided into first two stages of Kotter (1996). The accessibility and integrity are also another interpretation from what Kotter (1996) says in the communicating step and the short term wins but the role of consolidation in culture is what Latham hasn’t expressed. Kotter (1996) has tried to design the more specific steps while Latham (2003) represents his five steps in a more abstract way to be flexible enough in practice.

### 3.6. **Change and culture**

Organizational settings often come with an ambition to change the organizational culture. Formally, organizational culture refers to the shared values and norms which differentiate organizations (Latham, 2003). The Organizational culture can help in both strategy formulation and execution. In fact, the culture illuminates how things are done in organization, so before every change strategy, management should be aware of the organizational culture (MCallaster, 2004). Organizational culture is
"values and norms, myths and sagas, language systems and metaphors, symbols, rituals and ceremonies, and the use of physical surroundings including interior design and equipment" (Shrivastava, 1985). Those factors are perceived as the cultural artifacts. Cultural artifacts help in better managing change. The supportive systems such as the reward system also reflect the concept of organizational culture and should be noticed and managed in a change process. If the outcome is a change in culture then managers should work with those cultural artifacts to change the culture (Higgins and MCallaster, 2004). Empirical studies have shown that companies which could take new cultural artifacts had better performance in their change program (O’Reilly, 1999). Myth, language systems, symbols and new physical surroundings are those cultural artifacts that affect on people behaviors and smooth the change acceptance. The reason behind its effectiveness is; if the cultural artifacts are the same as in old systems, they do not support new change objects. Cultural artifacts impact on change glimpse from the employee eyes and shape their intuitions about the change ahead.

Organizational culture also is different in the case of public and private sectors. They have different values and norms. A deceptive belief is to think “if one strategy works in a place; it will work here” (Crucini and Kipping, 2001). Public organizations often come with the different missions, history, competencies and the strong traditionality. Traditions have a determinant role in the nonprofit organizations. Traditions define their mission, expertise and relations (Salipante and Golden-Biddle, 1995). In order to lead a successful change in nonprofit organizations, it is unavoidable to be aware about the role of traditions and type of changes. An organizational change should respect their traditions and try to utilize them into the new goals. Traditions also may dictate that whether the change is needed or not. Based on traditions and the great role of organizational identity, there are four types of changes in relation to their affects on nonprofit organizations which presented in Table 2.

<table>
<thead>
<tr>
<th>Altered view of organizational identity</th>
<th>Environmental Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>high</td>
<td>high, fundamental, significant</td>
</tr>
<tr>
<td>low</td>
<td>low, moderate, minor</td>
</tr>
</tbody>
</table>

In addition to organizational type, the national culture also has great influence on the change processes. Studies have shown that the financial performance is better when change programs are in congruence with national culture. National culture is defined as "common theories of behavior or mental programs that are shared"(Newman and Nollen, 1996). When management practices are not corresponding to national culture, people feel uncomfortable and take the aggressive
reaction against the change rather embracing it. National culture is sometimes
categorized with 5 dimensions; the distance of power, uncertainty avoidance,
individualism-collectivism, masculinity-femininity and the long term-short term
orientation (Newman and Nollen, 1996). National culture can leverage efforts to reach
a compromised equilibrium within the organization because it brings a better
understanding among the change agents.

3.7. Organizations as political entities

The classic paradigm of change is formal, structured and hierarchical, emphasizing
command and control. They reflect the managerialism and "top-down" models
(Finstad, 1998). Organizations in this sense are perceived as bureaucratic structured
systems whereas the change occurs within the manager's decisions while other
organizational employees are considered to follow their decisions. The strategic
vision, mission, action plans and so on, should lead the way of change and change
agents are performing their tasks that based on those directive plans (Sastry, 1997). In
opposite to top-down approaches, there is an emerging support for a contrasting
paradigm which interprets the organizations as non-linear with a political
environment. Change in this organizational nature is conducted and energized by the
competition of the social groups with conflict of interests and the different value
systems (Pettigrew and Whipp, 1991). Bottom-up approaches emphasize on the role
of informal systems. Some authors describe this organizational systems as "eruptive
systems" which attributed by self-development and the enactment (Finstad, 1998).

Organizations in the new perspective are assumed as political entities which
brought by heterogeneous groups with conflicts in interest agendas. In this context,
organizational field is defined as "network of social relations, structured systems of
social positions within, which struggles and maneuvers take place over resources,
stakes and access" (Oakes et al, 1998). Generally, expanding organizational form is
the combination of perspectives and interests which implies the role of power and
politics. These social and political processes in organizations are the inevitable part of
organizational change in future. Based on some empirical studies, managers and
especially the middle managers often undermine the corporate policies which are
against their interests or at best, look them as external tasks in immediate plans. It is
despite to the corporate compliance which is expected in classic view of change
(Hallier and James, 1997). According to the political view on organizations, scholars
have tried to frame informal processes in organizations with respect to the conflicts of
interests. A credible bottom-up model is needed to accept reality of change while
being capable of analyzing the influence of small groups. Therefore, some researchers
have introduced the re-shaping of organizations by the "great groups" or
"communities of practice". Those groups share tacit knowledge and "simultaneously
manage and repair the social context"(Bennis and Biederman, 1997).
All efforts to manage change in a political environment are created to model the politics at the heart of the change processes. The paradox of such efforts to model the political behavior of humans is the modeling of informal activities by the formal structure. There is still lack of conceptualization to go beyond perceptions of political nature and create the practical tactics. It seems that there is a potential field to work on proposing models which can respect conflicts between the sources of power while be able to achieve a compromised solution or equilibrium to gather those "hot groups" around one strategy. The models should be capable of making the credible change strategies that groups actually "want" to do it, not "must" do it. The compromised strategy means that the benefits of all stakeholders that will affect by organizational change should be arranged in such a way that there will be no better action for them except the equilibrium strategy.

Here in this thesis, sources of power or social compositions of people that discussed in this section and affect on organizational change treated as change agents to analyze problems of managing change. In this sense, change agents could have different meanings. Shareholders, managers, employees and generally any player that have effect on change is a change agent.
4. Chapter four: Theoretical background of game theory

In this chapter, the related definitions of game theory, its divisions and basic assumptions are discussed. There is a wide variety of game theoretic divisions and applications but those theories that are capable of being used in managing change have been expressed. In addition, the basic concepts of game theory like the Nash equilibrium, equilibrium analysis and the behavioral game theory are presented but the complex game theoretic methods that are not practical in the organizational change have been omitted.

4.1. Strategic behavior

In order to understand the game theory, the concept of strategic behavior should be reviewed. Game theory is fundamentally based on strategic behavior, but strategic behavior is not truly logical or reasonable behavior. It is a more general concept, “Humans are strategists, whether we like it or not, so it is better to be a good strategist than bad one” (Dixit and Nalebuff, 1991). The common element of all business and life situations is, we are among active decision makers whose choices interact with us. These interactions are parts of our thinking. Other's aims often conflict with us, so we must be ready for conflict and utilize the cooperation. At this social context, a branch of social science that studies the strategic decision making is called game theory. It can be applied in social interactions with three properties: (Colman, 1999)

- There are two or more decision makers called players.
- Each player has a choice of two or more actions that called strategies. The outcome of interactions depends on the strategy choices of all players.
- The players have well defined preferences among the possible outcomes. The payoffs need not to be financial, but players are still assumed to have preferences over the different payoffs.

Any social situation with mentioned properties can be interpreted by the game terminology. In a game situation (interaction situation), each player has a partial impact on the outcome of the game. The concept of game is not as people simply think about that. Any conflict of interest with those requirements, like many daily problems in economy, policy and management can be modeled by the game theory (Zagare, 1986). In other words, game theory wants to say "no man is an island". This is because the focus of game theory is on interdependency and interactions. In this interlinked situations, all of a group will be affected by the decisions of each individual member. The analysis of such interconnected situations tends to ask questions like (Dutta, 1999):

- How each player guesses about others choices?
• What actions should be taken in comparison to other players?
• What will be the outcome? Is it good for the group as a whole or just for one member?
• Will there be any difference if the game can be repeated more than once?
• How will the strategies change, if each member becomes unsure about the outcomes and strategies of others? (generally about other's characteristics)

Game theory wants to analyze those mentioned and other related questions. Historically, the origins of game theory came from the early mathematic articles in 1920, but this new field of knowledge was established by von Neuman and economist Oskar Morgenstern (1953) in “theory of games and economic behavior” (Neuman and Morgenstern, 1953). They characterized the optimal solutions for specific games. Other scientists like John Nash (1959) introduced the equilibrium (a solution) to games that will be explained later.

4.2. Rules of games

Each game should be specified before the analysis. It means that we should clarify these four principles:

- **Who**: knowing the group of players who interact.
- **What**: the choices, alternatives, actions or generally strategies that each player has.
- **When**: the time for each player to get in. (in what order?)
- **How much**: the amount of each player’s gain or loss by his/her choice of action.

The basic principles represent the rules of a game. The important question about the rules is; do players know the rules? In game theory, there is an assumption called "Common Knowledge". Common knowledge assumes that all players know the constitution of a game (game principals). It does not mean that each player is equally informed; it simply means that they know the same rules. Common knowledge goes further and claims that; in a game, all players know that the constitution is available to all and everybody knows that everybody knows that the constitution is available and again everybody knows that everybody knows that everybody knows…infinitum. This standard assumption called common knowledge (Bernheim, 1984).

4.3. Forms of games

There are two ways to represent games before analysis; they are extensive form and strategic form. Extensive form is a pictorial way of representation which covers the rules of who, what and when. It is also called the game tree, because it shows the main root of game, its branches and regularity (Osborn, 2003). Each branch shows one possible strategy. Branches start from the nodes that express the regularity.
Game Trees vary from simply two players game and the limited sequences of strategies towards the complex trees with different players and the stream of sequences. Figure 4 implies one simple game tree. The extensive form does not represent only the sequential actions. It is also possible to demonstrate the simultaneous moves of players in a game tree. The key point is the players either choose to act at the same time with other players or actually take action after other Players, but they are unaware about the opponents’ choices of action. The simultaneous move can be shown by one oval that encircles two nodes. The two nodes which are collected in one oval describe that player 2 does not know whether player 1 has selected strategy C or N. Figure 5 express that players cannot distinguish which action has been taken before.

In addition to extensive form, we can use the strategic form by a table. Strategic tables consist of rows correspond to strategies of player 1 and columns that are strategies of player 2. Each cell in this table addresses the rule of "How much" that is corresponding to specific pair of strategy. In other words, the pay offs for each player have been written concerning the opponents’ selected strategy. Whenever we have two players we can make a strategic table to show a set of strategies and payoffs. The strategic form cannot represent the rule "when" and mostly is suitable for simple simultaneous games (Osborn, 2003). A strategic table is shown in Table 3.
Extensive and strategic forms of games are two ways of representing a game and can be used together or synthesized. The payoffs also can be written on each node in the extensive form, but the strategic form is useful to find the solution in simple games. When the payoffs are monetary, we can simply write the numbers but when there are nonmonetary outcomes, we use the utility function. Utility function illustrates the preferences of player in comparison to others. Utility function can be a simple rank of strategies 1, 2, 3… which represent the most preferred strategies in response to opponents’ strategies (Watson, 2002). It is possible to call those ranks as payoffs.

Game theoretic analysis can be more complicated if the outcomes are not known for sure. This can be happen because of variety of reasons; one player can choose his/her strategy by the probability like he/she may use a toss or coin to select the strategy by chance. It is also possible to see an inherent uncertainty (Helbing, 1996). In these cases, utility function that is based on a simple ranking is not enough. In the literature, it has been discussed as: "Under what conditions can we treat the payoff to an uncertain outcome as the average of the payoffs to the underlying certain outcomes?" (Dutta, 1999). In spite of the deep mathematical discussions over game's uncertainty, many of real games can be treated by normal utility functions. In the real games, there might be enough to find an approximate solution, not the accurate optimal one.

4.4. Game theory and mathematics

Mathematical game theory is thought by some as normative theory not as positive or descriptive theory, so it cannot be used for predicting, and it is hard or might be impossible to be tested by experimental methods (Zagare, 1986). The remarkable note could be the game theory is much more than a mathematic theory in its non-mathematic applications. Informal game theory can be considered as a positive or descriptive theory, capable of explanation and prediction. It can provide certain important features and frameworks to describe the individual and collective rationality, cooperation and competition, trust and suspicion and threats and commitments (Dixit et al, 2009).

The applications of game theory in organizational change as a part of management concepts can be traced like its applications in the strategy research. Game theory in
strategy research can be applied through three elements: Games, game theoretic reasoning, and equilibrium points (which are determined by game theoretic reasoning). The main conclusion is that games taxonomy and equilibrium analysis can be useful even if finding the exact amount of equilibrium points is too complicated (Camere, 1991). However, mathematical game theory is mostly around logic and algebra. Game types can provide the taxonomy of interactive situations, like the biological classification of species or the periodic table of chemical elements even without equilibrium analysis (Aumann, 2000). Game theoretic reasoning could be difficult and may need adequate knowledge but equilibrium may result from the equilibrating forces other than reasoning (Camere, 1991).

4.5. Static and dynamic games

Researchers divide games according to different aspects, but a simple game taxonomy is represented here; the dynamic and static games. Chess is a dynamic game because one player starts then another player and then the first player continues. On the other hand, auctions and bidding are an example of the static game (simultaneous move) because nobody knows what offers will be revealed from the rivals. The main distinction between static and dynamic games refers to how players think and act (Aumann and Hart, 2007). In dynamic games, players should think like; if I take this strategy, how will others react in their round? It implies an investigation of future effects of each action. On the other hand; in static games, each player should think about what others want to do now? It does not mean that static games are not sequential. Notwithstanding to what actions have been taken before, while a player is not aware of previous moves, it is a static game. Games of the real world are mostly a mix of static and dynamic games. For instance, two companies that are working on the new product development often are not aware of the others moves and strategies, so it implies a static game. (Telser, 2007)

4.6. Conflict and cooperation

In some games, the amount of payoff for one player is constantly equal to what rivals are losing. It means that the winning of one is associated with the failure of another. These games called "Zero Sum Game" that has a complete conflict of interests. However, most of games in management, business and life are "Non Zero Sum games" (Dixit and Nalebuff, 2008). Even a war is not a complete Zero Sum game. It is always possible to have cooperation between players which can lead to the better results for everyone not just for one player. It is not necessary to have the same benefits or even the same direction of benefits to create cooperation. Players with different direction of benefits can cooperate for a better group result, but the fact is that conflicts will arise when they want to share advantages. (Hill, 1990)
4.7. Games and information

Games also can be divided by the role of information. In a game, previous moves can be known for a player or not. If there is a history of game involving all players moves in past, it is called game with the perfect information. On the other hand, if there is lack of awareness for at least one player, it is the imperfect information game. It is possible for one player to have more information that called an asymmetric information distribution (Rasmusen, 2007). If one or some players do not know the payoffs, there is also asymmetric information game. In these games, players try to achieve more information while players that have more information will try to manipulate information. One of the general principles is; if a player has extra information, he should not necessarily share all he has. (Roland and Laroque, 1992) Players often reveal the information which will lead to a desired behavior of rivals. It is notable that the opponents also know that we are showing the information that intentionally manipulated; so they start to hesitate about the received information.

4.8. Dominant strategy

In some games there is a dominant strategy for all or some of players. Dominant strategy is the best strategy for one player regardless of what the other players choose. By definition, a dominant strategy is the strategy which the payoff to that strategy is strictly greater to any other strategy, irrespective to what strategy is chosen by other players (Watson, 2002). One of the main advices of game theory is “use the dominant strategy when you have that” (Dixit et al, 2009). The example in Table 4 shows a dominant strategy. We have two players and each player has two strategies.

Table 4: An example of strategic table shows the dominant strategy.

<table>
<thead>
<tr>
<th>Player One</th>
<th>Player Two</th>
</tr>
</thead>
<tbody>
<tr>
<td>High/1</td>
<td>14,14</td>
</tr>
<tr>
<td>Low/1</td>
<td>16,-1</td>
</tr>
</tbody>
</table>

In each pair of strategies, first number is the payoff for player that is assigned to rows of the table and the second number is the amount of payoff for the player that is in the column. For player 2, the strategy of south is dominant because the payoff is better regardless of player 1 chooses high or low. For player 1, the strategy of low is better irrespective to fact that player two wants to select north or south. When all players have a dominant strategy then it is called dominant strategy solution. A dominant strategy solution is like (1, 1) in the Table 4, those two dominant strategies crossed each other.

If payoff for one strategy is at least as well as other strategy payoffs, then we call it the weakly dominant strategy (Compare to strict greater in dominant strategy). The
slightly weaker domination comes when one strategy is better than other strategies but not always strictly better. According to definition, some of strategies may be dominated by other strategies. No rational player selects a dominated strategy and expects the other players to select from their un-dominated strategies. If a player knows that one of his strategies is always worse than other strategies, he never wants to use it (Dutta, 1999). It is also notable that other players realize this fact and try to take into account this thinking method about each other. This simple concept has very important advantage in game solutions. According to literature, dominated strategies can be removed at each round until the final solution is achieved. This is iterative elimination of dominated strategies is called IEDS method (Osborn, 2003).

Elimination of dominated strategies will narrow down the area of solutions. Not all games can be solved by finding dominant strategies or IEDS method. If there are a lot of rounds of elimination, it is reasonable to hesitate about the solvability of a game (Watson, 2002).

4.9. Nash equilibrium

Nash equilibrium is the most common solution to many of games. The fundamental idea is to find the set of strategies for each player which can best serves his/her interest, in response to other players’ strategies. If we have such strategies, neither player has motivation to change his/her choice. It can be an outcome that is stable in the game because the benefits are really tied to each other. It means that there is no better strategy for all players in response to other's selected strategies (Nash, 1950).

Each player has beliefs about what the others do and each player has knowledge and an analysis about what he/she should do. The motivation of Nash equilibrium which expressed here is parable, but some of these parable motivations are working accurately in the mathematical models. Nash equilibrium point is the point where the action of each player is the best for him concerning his beliefs about others’ actions while the actions of others are also consistent with his beliefs (Watson, 2002). In most game situations, Nash equilibrium is the best starting point to analysis. It can lead to a new frame work to think about the game solutions.

The Nash equilibrium wants to demonstrate the best strategy in respect to others or with having the given beliefs about others’ actions. It shows that in which condition the benefits will be tied to each other and what ultimately the players will do; given a set of assumptions. The reason behind this strategic tie is that nobody has a better action in respect to others; hence, players do not want to move out of equilibrium even when there is a better point of benefits for all. The method of finding the Nash point has simply been shown in Table 5:
In order to find the Nash point, firstly, each strategy of one player should be assumed as determined. For example; what is the best response of player 1 given the C strategy of player 2? It is clear that player 1 select the strategy B. This question should be continued for both players and all strategies. If we continue this method for all cells (pair of strategies), Nash equilibrium appears where the payoffs are both the best responses to each other. The configuration of strategies which is the best response to other player while it serves the players itself is (5,4). It appears when player 2 selects M strategy and player1 selects L strategy. Both payoffs in that cell are underlined because both payoffs are the best responses. None of other configurations satisfy preconditions of Nash equilibrium. In order to validate our answer, we can ask for example; if player one select strategy H, what does the player 2 do? Of course, selecting the strategy C; but now the important question is, does player 1 select strategy H when player 2 selects C (Backward Questioning)? According to table, No. in fact when player 2 wants to select strategy C, the best reaction of player one is selecting strategy B. It implies that the configuration of (H, C) is not the Nash point because they are not the best response at the same time. In other words, it does not imply the true belief about each other, because if player 2 thinks that player 1 will react by H against his C, it will fail. That is not the best reaction of player 1 to strategy C.

The concept of equilibrium does not express the best results for all players. It does not mean that at Nash point, all players gain the best benefits from a game. The best result for all can be another configuration of strategies with effective cooperation and commitment (Milgrom and Roberts, 1990). As it is obvious from Table 5, the cell that presents (9,7) has better results for both players than the equilibrium cell (5,4). Movement from the equilibrium to another better point always needs "effective cooperation", "commitment" and "credible strategies" (Dixit and Nalebuff, 2008).

Based on discussion about Nash equilibrium, two main questions immediately arise; do all games have Nash equilibrium? The answer is essentially yes, it is possible but by generalizing the concept of equilibrium and by entering the probability functions instead of certain payoff amounts. This is called mixed strategies. When there is no pure Nash solution, there is a mixed Nash solution. The second question is;
does every game have one Nash point? The answer is no. some games have more than one Nash solution.

Focal point: Multiple Nash equilibrium is common in game theory and there are different methods to find and select one of them. The role of culture, ethics and history comes into game terminology from the fact of multiple Nash equilibrium. The concept of "focal point" has been discussed when players use the role of common cultural elements to focus on one of equilibrium points and coordinate with each other. Schelling (1958) for the first time introduced this idea and developed that. The concept of focal point refers to its "distinguishing ability". Nash equilibrium itself is also a focal point because it distinguishes the characteristics of Nash point among other configurations of strategies. Distinguishing ability is an interesting factor and need more thinking to understand. It is like the role of highlighting when somebody reads books. Eyes naturally focus on highlighted sentences while automatically leaving other lines. (Posner, 1998)

Pre play communication: Do players really reach the Nash equilibrium by rational thinking and rational actions? The answer is “not necessarily”. I will discuss in behavioral game theory in section 4.14 about that, but the fact is if players have some meetings or negotiations before game, they can share their values, norms and strategies. Sharing the knowledge about strategies can help them to be aware about the previous rounds and pay offs and will persuade players to act strategically by thinking strategically. This trial and error process eventually leads them to reach the equilibrium point. In evolutionary game theory, it is discussed how players can reach a rational equilibrium point even without the rational actions and reactions (Camerer, 2003).

4.10. Backward induction

Games are simultaneous or sequential. In dynamic games, players decide sequentially. In those games, players have knowledge about the history of game like which players have played and what decisions have been made. Usually, the extensive form is suitable to analyze dynamic games. To solve the games which have presented in extensive form, the backward reasoning or "backward induction" is used. In simple words, a player should anticipate where his initial choice ultimately leads and must use the information of final result to step back and calculate his best choice at the starting point. A player should forecast his own future choices and also the other player’s choices, putting himself in their shoes and figure out different possible interconnected outcomes (Aumann, 1995).

Briefly, a player should suppose that the game is at final decision node, it means that by any decision, game ends. The player should take the best choice to maximize his payoff on that penultimate node. At the penultimate node, player can compute the exact amount of payoff, then he has to step back in game tree and use the same analysis until reach the beginning (Aumann and Hart, 2007). The logic of backward
reasoning has the same concept as dominant strategy and IEDS in the strategic form. Backward induction is a general solution to all games of perfect information which also are finite. The final solution shows also the Nash equilibrium of that game.

In order to solve the complex game trees, the concept of sub game perfect equilibrium was introduced. The idea here is that some parts of a game tree can be a complete game itself. As Figure 6 presents, a sub game is a collection of branches and nodes. Sub games start at a single node and involve every successor to that node (Aumann and Hart, 2007). A sub game contains all future consequences and also all information for that specific game. The best solution for any specific sub game is the equilibrium in which no player has motivation to change his strategy and the best solution for the whole game will be a "sub game perfect Nash equilibrium" when all of the included sub games have the Nash equilibrium (Dutta, 1999). It is obvious that each strategy contains a set of moves. For a strategy to be considered as Nash strategy, all moves of that strategy in its sub games must be Nash solutions of those sub games.

4.11. Mixed strategies

Pure Nash equilibrium arises when players have true beliefs about the other players’ strategies and these beliefs are certainly true. When there is an uncertainty about rivals, the concept of mixed strategy comes to equilibrium analysis. Mixed strategy presents the probability of each pure strategy (Harsanyi, 1973). In other words, mixed strategy is a probability that each player has about others’ strategies. In fact, each player wants to guess and determine that what is the probability of others’ strategies to maximize his/her benefits? Mixed strategies should answer questions such as; what is the best probability distribution over my strategies to maximize benefits? In Nash equilibrium of mixed strategies, each player has the best response to others best mixes of strategies. The equilibrium here determines what the best probability distribution over the strategies is (Aumann and Hart, 2007).

There is a simple way to find the Nash point of mixed strategies. The equilibrium appears when each player uses a kind of arrangement of strategies that make the rival indifferent. When the opponent is indifferent about his strategies, then it is the best response or best mix of strategy. The logic behind the making players indifferent was also justified by mathematical reasoning and associated graphs (Dixit et al, 2007). Based on the pure strategies and the concept of payoff, it is remarkable to know that
4.12. Repeated games

Game can be played for one time or can be repeated over time. Unrepeated games may tend to immoral or illegal actions by players. Beneficiaries of finite game may take the strategies that gain as much as possible, uninterested in the others’ benefits. In unrepeated games, there is a lack of information about players’ behaviors, capabilities and motivations. On the other hand, in repeated games, players may make trust and gain reputation (Kreps and Wilson, 1982). For instance, if a change in organization is perceived as one finite game, it is possible to observe the strange resistance and dangerous conflicts.

Most of the relations and interactions in business and life are long term and repeated. The relation between employee and employer is one of such relations that are repeated over time. The business relation between companies through supply chain and inside a company between departments also can be seen as repeated games. The behavior of player in repeated games helps to understand why the ongoing economic behavior is different as single economic interaction (Mailath and Samulelson, 2006). The intuition is simple, when players know that the future behavior will be affected by present interaction, they may behave in a different way. If there is a punishment or reward tomorrow, the current behavior should be strategic. Unrewarded or unpunished action will be considered in the strategic thinking. These actions and reactions of players in a repeated game (ongoing relation) can be modeled by game theory.

In formal expression, as illustrated by Figure 7, a repeated game is a stage game with the number of repetitions, t. If the number of stages is fixed then it is called finitely repeated game and when the number of t is not known, it is an infinite repeated game. The payoff for the game is the sum of payoffs of each stage. In repeated games, players may sacrifice the short term benefits within some stages of game due to the long term advantages.

Figure 7: Figure shows the concept of stage games in a bigger game
Backward induction which has been discussed is the only way to find the Nash equilibrium of a stage game. To make a credible cooperation in long term relations, there should be credible reward or punishment strategies. Cooperative behavior leads to result that is better than Nash solution. From the game theoretic view, if one player decides to swerve from the agreement of cooperation, others have to implement a distinct and predictable punishment profile. Players naturally think about cheating and try to compute their payoffs under different scenarios (Crawford and Haller, 1990).

4.13. Behavioral game theory

Game theory implies awareness about the value system of different players. Players may have perfect knowledge about other's objects in simple games, but in many real games of business, politics and life, motives are complex combinations of selfish preferences, altruism, environmental concerns, fairness and long term considerations (Watson, 2002). People are not always hypothetical "rational persons". Players in a social game should put themselves in other's shoes. The main aim of the behavioral game theory is to address: Do we observe exactly the outcome that we expect from equilibrium reasoning? Do players finally reach the solution that game theory suggests? (Camerer, 2003)

Game theorists perform many experiments and play laboratory games to find answers of those questions. The results of these experiments are sometimes different from what the theory claims. Game theorists have designed different games to analyze human behaviors in real games. Emotions, hormones, and genetic causes are all contributing to result of experiments (Camerer, 1997). The acceptation of one hypothesis does not mean that the others should be rejected. People are the mix of altruism, fairness, social concerns and genetic backgrounds that develop their rational strategies over time. Development of rational behavior also implies the role of learning in game theory. People who observe games or played some rounds, usually gain experiences and take more strategic actions (Gale et al, 1995).

Behavioral game theory generally aims to extend people behavior by taking other motivations than pure rationality into account (Dufwenberg and Kirchsteiger, 2004). A manager needs to find the right balance of self regarding and other regarding behaviors. Genetic causes, moralistic aggression, social improvement, equity, fairness and cultural facts are those "other regarding" behaviors that each is contributing to outcome of a game. Behavioral game theory sees those facts and also the role of learning and evolutions (Camerer, 2003). In order to conclude the behavioral game theory, game theoretic analysis is a good point to start but a good player should combine it with his/her experiences.

4.14. Examples about applications of game theory

Applications of game theory in various fields of knowledge have been unfolded. Here, there are some brief examples of real life applications which can lead this
research to follow the past line of game theoretic applications. In order to get closer to the concept of game theory, it is useful to perform an overview of applications before going further.

**Group projects:** Groups can involve players that work on a project and the fact is a certain amount of work is needed to finish the project. If one of the group members or players wants to slack off, others must do extra work to get the project done. In this context, strategic game is estimating the likelihood of freeloaders (Grossman and Hart, 1980). A rational player needs to think about the benefits of project against the costs of extra work. The group working can be more complex when there is a conflict of interests and different value systems about the project objectives. A stable solution should consider all players’ self interests and the group interest (Mulere, 1995).

**Economic and finance:** In most business sectors; there is a problem between being a market leader or a good follower. Firms can pay high expenses of R&D and be the market leader or wait to use patents and be a good producer. By attention to huge R&D expenses like 20% of profit, it could be a considerable trade off (Dixit and Nalebuff, 2008). Drug industries are one of the important examples of the problem of "new product development". There are different game models to analyze the problem of new product development. On the other hand, auctions and bidding are also other examples of game theoretic modeling in economy. The competition between bidders is strategic and rational. Simultaneous or sequential game models have been applied for different auction conditions (Brams, 2003).

**Biology and law:** One of the interesting and growing applications of game theory in recent years is in animal behavior and biology. Animals normally have to compete for the scarce resources. The problem here is the costly fighting. It is costly but unavoidable because the resources are restricted (Smith, 1982). Strategic and rational behavior arises when they naturally analyze their behaviors in relation to their short term and long term goals. The management of natural resources and the international conflicts between countries over environmental aspects can also be reviewed under this terminology (Böhringer et al, 2002). All countries gain benefits from having a good environment while each has its own interest to use as much as possible and to improve its economical condition.

**Strategic management:** Scientists have argued that there is a significant potential for development of "metaphorical" models that capture the broad qualitative features of strategic interactions (Saloner, 1991). They are working on the nature and the role of game theoretic modeling in strategic management. Their aim is to explore its potential for contributing to empirical work and providing advice to managers about effective business strategies by developing the frameworks that are based on the insights of game theory. They believe that “After 50 years as a mathematical construct, game theory is about to change the game of business” (Brandenburger and Nalebuff, 1995). The move from win-lose to win-win situations is one of the
interesting fields in business strategy that was exploited from the game theory insights. Firm’s strategies and organizational behavior seem to be a major sociological tradition, but different researchers have merged new models in combination with game theory. They argue that game theory can offer a mathematical model of organizational ecology (Witteloostuijn et al., 2003).

**Sociology:** The applicability of a generalized game theory seems to be possible. In some works like socio cognitive mechanisms of belief change, scholars have tried to use generalized game theory (GGT) to conceptualize and explain the key socio-cognitive processes in multi agent interactions and in particular, belief revision (Burns and Gomolin’ska, 2001). In such works, generalized game theory has been applied to analyze and individual and collective learning process and particularly changes that occur in beliefs. The role of Relationships among agents and information transformation issues has been considered in such efforts.

### 4.15. Main categories of game theoretic applications

The investigation of theoretical background and especially the overview of past line of game theoretic applications lead to conclude the main application areas of game theory. The nature of game theory and its related definitions along with the areas the purposes of game theoretic applications in other fields have guided to infer the main categories of game theoretic applications. These divisions are presented below:

**Analysis and interpretation:** In this case, game theory gives another perspective to look at social situations. In fact, game theory brings new glasses to see, interpret and formulate problems. Here, Game theory is a descriptive tool which helps to gain some insights in social situations that have conflicts of interests. It does not come with specific solution rather helps change agents to be equipped with another analytical tool and decide what strategies should be taken or how they can overcome change difficulties. However, game theory brings new ideas to solve problems when it comes up with interpretation but it does not have prescriptive suggestions. It also might be with predictions about behaviors and possible outcomes.

**Strategic formulation and abstract advice:** Game theory with a taxonomy of games help to find similarities between new problems and predefined famous games in order to give game theoretic formulation. Game taxonomy along with equilibrium reasoning creates strategic advice for managers. Equilibrium reasoning takes the logic of Nash equilibrium and generalizes that in strategic advice that are not precise with detailed solutions like in economy but imply brings new logic and language in interactive situations. Sometimes, strategic lessons of game theory were elicited from behavioral game theory and its practical examples.

**Equilibrium reasoning (solutions):** Game theoretic applications in economy and biology give some precise solutions. Game theory in this sense can be used to model a
problem and find the Nash solution by the mathematical analysis. Solutions of those
modeling sometimes are based on simplified assumptions. Results of modeling can
also lead to new insights and managerial lessons. It is important to consider that often
a simplified model is enough, because the generalization and finding solutions of
complex formulations are possible by software packages.

Those main applications of game theory can be mixed in different situations. They
are not separate functionalities of game theory rather are more complementarities to
each other. Therefore, it is possible to use one or some of them in one problem.

The main game theoretic applications that discussed above represent themselves
during the chapter five in analysis of organizational change problems. Each problem
may utilize one or some of those main functionalities of game theory.
5. Chapter five: Applications of game theory in organizational change

This chapter is the synthesis of what have been discussed during chapters 3 and 4 towards the applications of game theory in organizational change. The methodology of the thesis in chapter 2 helps to understand how the synthesis is accomplished. In this chapter, problematic areas of organizational change as well as mechanisms of applying game theory and detailed analysis of problems are presented. At the end of this chapter, an instructive framework was created to conclude the results and illuminate possible patterns of using a game theoretic approach in organizational change.

5.1. Mechanisms of game theoretic analysis

Four mechanisms were used to analyze change problems by game theory. These mechanisms were elicited from the theoretical background of the thesis and it was tried to explicitly conclude the methods that different authors used in their analysis. The use of mechanisms is related to the specific problem characteristics. The mechanisms are in fact the instrumental core of the game theoretic approach in organizational change are linked to each other and can be used together in change situations. These analytical tools are not separate methods to find the solutions and it might be difficult to distinct them. For instance, behavioral game theory provides a direction for other methods to be tested by empirical studies, while it has its own definitions and subsidiary methods.

Sub games: Sub games or game examples are the general games in their simplest form in order to understand the logic behind change situation. Sub games have similar or in some cases, identical mathematical forms and solutions. The extensive and strategic forms of sub games often follow the same way. Using the same formalism helps to transfer knowledge from one situation to another. Depending on the specific assumptions of problems, these sub games are then capable of being generalized. There are various game examples but those sub games that can be applied in change management are introduced and analyzed in this chapter with proper solutions. In this chapter, some game examples like "prisoners' dilemma", "battle of sexes" and the game example of "principal-agent" is introduced with related solutions.

Practical games: Practical games are the specific real problems that were solved by game theoretic analysis and have become good examples in other game theoretic applications. In order to discover the possible applications of game theory in change management, this research has tried to extract lessons from some practical games in reality. Strategic advice from the practical games might be derived from the apparently dissimilar situations to change management. However, useful insights for organizational change can be achieved using analogical assessment. The problem of “drivers’ behavior” and the subject of “racial segregation” or tipping points are two
practical situations where game theoretic reasoning was used and it seems that they are also useful in managing change.

**Specific modeling of change situations:** In addition to existing game examples and practical games that were suggested so far, it was tried to model some change difficulties by new modeling that was derived from the theoretical background of game theory. The main functions of specific models were used to extract the essence of the analyzed problems in more simplified way. Specific problem formulations for two change problems are presented in this chapter. Group dynamics in change management and the problem of incentives and rewards are those change situations that was modeled by game theory with proper solutions. The necessary theoretical foundations of those two models were explained earlier in the theoretical background.

**Behavioral game theory and change management:** In each section of game theoretic applications, the issues of behavioral game theory are discussed. How people really play the strategic games reveals some useful lessons for managing change. It is true that some specified situations need modifications and taking new assumptions into account but it is not reasonable to abandon the theory, because it is a good starting point for analysis and conquering the problems. In each problem area, there is a part about the implications of behavioral game theory in that specific situation. Behavioral studies of games also give a direction to perform more grounded experiments in each change situation. The definition of behavioral game theory was discussed in chapter 4.

### 5.2. Main problematic areas of managing change

An integrated study of the theoretical background of game theory and organizational change has been done to introduce the main problem domains of organizational change that game theory can be applied to. The problem areas of organizational change that game theory has potential to give solutions to are:

- The problem of making cooperation and coalition
- Difficulties of group dynamics
- The problem of incentive rewards

Definitions of each problem domain and its motivations are mentioned during sections 5.3 and 5.4 and 5.5 of identified problems and before its relevant game theoretic analysis.

### 5.3. Cooperation and coalition in managing change

Most of the literature in organizational change mentions the role of cooperation among changes agents to lead successful change. Hence, the coordination of the actions of human agents is an inevitable part of each change process. Synergetic impact of group works in managing successful change is the reason why people should work together in order to implement change. This fact is sometimes mentioned
as the first step of a change plan (Kotter, 1996). Coordination and cooperation in a game theoretic view is mostly based on what is discussed in political organizations. Coalition is a compromised approach in such a way that there is some sense of commonality of interests and also conflict of interests. Coalitions in this context occur between social groups or sources of power that have different value agendas (Pettigrew and Whipp, 1991). Conflicts between change agents should be addressed by cooperative change strategies.

Some researchers believe that "change often lead to waste because some one's turf have been invaded or particular department felt slighted by the process they perceived was used" (MCallaster, 2004). The conflict between sources of power in organizations justifies the need to make an effective coalition. A political coalition is based on analysis about sources of power in organization, knowing who will support the change and who not and why. People who will be affected by change should be viewed as, if they select to cooperate or defeat. Some changes in organizations may lead to people having to leave personality, prestige and organizational identity. Those factors tend create conflicts between different layers of management and change agents (Sherer and Lee, 2002). There are many empirical evidence which show change problems that ultimately imply political difficulties. Changes that affect distribution of power like new management systems or re-structuring of organizations are those cases that reflect the problem of different interest agendas. (Yongbeom et al., 2005; Besson and Rowe, 2001)

The context of game theoretic applications is mostly related to what authors called "heterogeneous groups" (Dansereau et al., 1999). Organizational units are interdependent with commonality and conflict of interest in this context. Effective cooperation and coordination in heterogeneous groups will be achieved if managers understand the preferences of people and try to balance the outcome that they expect from change.

5.3.1. Applications of GT in making cooperation and coalition

Because of the unique importance of cooperation and coordination in organizational change, two useful sub games and two practical examples were selected and investigated here to find what game theory can promote managing cooperation and coordination.

5.3.2. Implications of "prisoners' dilemma" to cooperate behaviors

One of the most famous sub games is the game called prisoners' dilemma. It has been used to model different cases in sociology, policy and business (Aumann and Hart, 2007). A simple type of prisoner's dilemma in one round will be presented. Generalization ability and other issues about expanding this game are also discussed. There are different expressions about this game but I selected the simple and original one to start with:
**Formal proposition:** There are two suspects in a police office but, the police do not have enough evidence to prove which one is the guilty suspect. The police keep them in different lockups. The police detective asks them questions and the suspects should answer while they don’t know what the other suspect has said. A suspect can do two things; be quiet (M) or throw the guilt on the other suspect (F). Each act will result in payoff for them. If they both remain silent, it means those both are guilty and should suffer 1 year in prison, because there is no evidence as to which one is actually the guilty one. If one is quiet and the other one throws the guilt on him, he should suffer 9 years in prison and the other one who has thrown the guilt, will be free. If both say the other one is the guilty, then both have to suffer 6 years prison. What is the solution for this game? Strategic form of game which represents strategies and payoffs is shown in Table 6.

**Table 6 : An example of the sub game of prisoners' dilemma with equilibrium point**

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>-1, -1</td>
<td>-9, 0</td>
</tr>
<tr>
<td>F</td>
<td>0, -9</td>
<td>-6, -6</td>
</tr>
</tbody>
</table>

**Nash Equilibrium of game:** Based on what has been explained in the theoretical part, this game has a dominant Nash equilibrium. It means that for both players there is a dominant strategy regardless of what the other player do. According to the definition of Nash equilibrium, the Nash strategy is the best response of both players to blame each other or the configuration of (-6, -6). The method is simple as cell by cell finding (recall theoretical background).

Generally, each game that follows the structure in Table 7 is the prisoners' dilemma sub game.

**Table 7: Table shows the general sub game of prisoners' dilemma**

<table>
<thead>
<tr>
<th></th>
<th>M</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>β, β</td>
<td>θ, α</td>
</tr>
<tr>
<td>F</td>
<td>α, θ</td>
<td>γ, γ</td>
</tr>
</tbody>
</table>

And we should have: \( \theta < \gamma < \beta < \alpha \); it will be a prisoners' dilemma game formulation.

**Change management proposition:** We want to see how GT looks and interprets the problem of cooperation in change. This game reflects a situation in which each change agent has a personal incentive to choose the strategy that ultimately leads to a result that is bad for whole of change when everyone similarly wants to do what his personal motivation tells him to do. Strategies in this game can be labeled as
"cooperate" or "defeat" (Dutta, 1999). It is also possible to call defeat as "cheat". It refers to the fact that, each player has a temptation to put the guilty on the other player, regardless of what the other player do, but if they both follow what their personal motivation dictate (defeat), according to prisoners’ dilemma in Table 6 both gain bad payoff, (-6,-6). It is clear in the table that if they both decide to hold out (cooperate), both gain better payoff (-1,-1). If involved change agents (agents can be different sources of power like senior managers, middle managers, shareholders, heads of functional departments or employees) in reality pursue their own self interests, the outcome does not lead to the best solution for all. Questions like: “How we can cooperate?” or “How we can have a credible commitment for cooperation?” will arise after the change proposition of the game.

**Generalization ability of the prisoners’ dilemma:** The results of practical prisoners' dilemma will be addressed during implications for change, but it is notable to say that nature of prisoners' dilemma (PD) makes it very useful tool to model different interaction situations in business, strategic planning and especially politics. Those games of real world are "Repeated prisoners' dilemma (RPD)” (Reily et al, 2009). Most of real interactions are ongoing which can be defined as repeated games. It is also possible to have a dynamic game with an extensive form in which some prisoner's dilemma in some stages is embedded. Stage games and repeated games are addressed in the theoretical background. Different researchers also have applied PD in laboratory situations to discover how humans are behaving in real situations. The results of such efforts of behavioral prisoners' dilemma are also represented.

**How PD can help better leading to change:** According to what have been mentioned about the main categories of GT applications and coordination and cooperation in organizational change literature, the main implication of prisoner's dilemma could be "How to achieve Cooperation?” It is clear from the strategic proposition that the natural strategy of players or Nash equilibrium would be "defeat" because they both are driven by self interests. If we want to achieve cooperation, there are two choices for people, "cooperate" or "defeat". Theory of prisoners' dilemma and experimental observations of the prisoners’ dilemma has advanced during last fifty years of invention and different knowledge and evidences have been accumulated and discussed in new efforts. For the level of analysis that my thesis is following, the main results of cooperation strategies was discussed, not detail mathematical models that were used before conclusion. These are different lessons and managerial insights to make effective cooperation from applied prisoners' dilemma.

**Reward strategies in PD and change management:** The other side of achieving cooperation is avoiding defection. Because of temptation to cheat from equilibrium (defection), an incentive reward can be given to player (change agent) to cooperate or a suitable punishment can be designed to stop him from cheating. Depending on lessons from game theory, the reward approach can be problematic in internal manner because if the reward should paid before taking action, it is possible to pocket the
reward and then cheat or if promised to pay after action, the credibility of reward should also be verified (Prendergast, 1999). It is always possible for players to renege after the choice was made. The useful way to apply a reward strategy is using a third party where players deposit promised reward in his control. Third parties, who have sufficient motivation to implement cooperation among players, can play an effective role in cooperation. It could happen by role of government, labor union or mutually trusted consultancy to control amount of promised reward in change occurrence. More details of how an incentive reward can be model by game theory and different reward schemas will be discussed later with mathematical reasoning.

**Punishment strategies in PD and change management:** Based on the case of repeated prisoners' dilemma and what was discussed in the section 4.10 as "backward induction", punishment strategies are more usual in resolving dilemmas. This is because a game is a part of long term relationship and players can see choices that were made by each other and the decision to take the punishment or not. If the game is not repeated or limited in number like in fast change programs, that seems to be management fads or waves of change, then the size of the punishment should be as large as to convince players to cooperate. Robert Aumann received the Nobel Prize in 2005 for his work to develop the general theory of tacit cooperation in repeated games (Aumann, 2006). His work was to determine the amount of punishment in repeated games as well as developing the instrumental work to achieve cooperation. Mathematical models of incentive rewards for change successfulness also can be used to model the amount of punishment by opposite modeling. According to practical efforts to have cooperation in prisoner's game, there are a variety of notes and key points in publications like in (Axelrod, 2006; Camerer, 1997; Kreps et al, 1982; Crawford and Haller, 1990; Erik, 2007). In order to make a comprehensive framework, the main and important tacit cooperation methods have been gathered and are presented below:

- **Detection tactics:** A good cooperative strategy in change program should be able to detect cheating from cooperation as quickly as possible. It should be fast and accurate, because then the punishment can be on time and precise. It can reduce the gain of cheating, so the detection mechanism should be quick and be communicated among change agents to increase prospects of cooperation. In the business world, airlines have effective detection tactics about their prices by customer detection competition. The main reason is to find the cheating as soon as possible.

- **Clarity:** It is important to design clear punishments. Boundaries of acceptable behavior and consequences of any cheating action should be clear for players. Otherwise players may cheat by mistake or learn from game that the punishment is probable. Change agents try to cheat in "step by step" manner while increasing the amount of cheating.
• Certainty: Players need to know that punishment and rewards are determined and are not renegotiable. Problems in WTO (world trade organization) among countries are such examples of lack of certainty. Certainty about punishment of undesired behavior should be communicated and perceived as a factual reaction to the change agents.

• Size: The size of punishment should be suitable to deter player from cheating, but with limitations. Size should be considered as a tool to keep cooperation in change program, not destroy it. Errors and mistakes are an inevitable part of practical life. Size of punishment in change program should be an optimal amount between forgiveness and deterrence.

"TIT for TAT" strategies in PD and change management: Some researchers designed laboratory games to find what the best strategy for repeated prisoners' dilemma is. One of the main laboratory tests was formed by Robert Axelrod and was designed as a match between different scientists to find the best computerized algorithm in repeated prisoners' dilemma. (Axelrod, 2006) The winner strategy between different scientists from different countries was "TIT for TAT" strategy. More accurately, the strategy starts with cooperation in first round and then imitates opponents’ action from previous round. According to Axelrod's work, each effective strategy in prisoners' dilemma which wants to achieve cooperation should have four principles: (Axelrod, 2006)

• Clarity: in TIT for TAT, it is clear because everyone can get it and with no need for much thinking.
• Niceness: in TIT for TAT, it is nice because it does not start with cheating.
• Provocability: in TIT for TAT, it does not allow a cheat to remain unpunished.
• Forgiveness: in TIT for TAT, it is forgiving because it does not maintain punishment for a long time and it includes willingness to reconstruct the cooperation.

The reason behind effectiveness of TIT for TAT is, it supports cooperation when it's possible and avoids cheating and exploitation. Besides of this strategy effectiveness in simulation, it is possible to define cheating categories in agents' behavior and the exact opposite reaction against that. TIT for TAT says if you want to cheat I will cheat in exactly same amount and in long time relations it reinforces cooperative behavior. An estimate of the amount of defect from each change agent's behavior could be performed and communicated. Change agents are now aware that each cheating or non-cooperative behavior will be treated by the same punishment as their behavior. For example if you don’t have time to participate in learning occasions for new change of information systems, the company also doesn’t have time for you. The important point is, it is mutual which means it's valid for both sides and both know it is the accepted and normal behavior in company. For each undesired action there is a punishment of the same appearance, amount and concept.
In spite of the good results in simulation, there are some important criticisms about its practical use. In reality, it is always possible for a small mistake or misunderstanding to occur. If one mistake of any kind happened in this game, then each player according to this strategy would react with a defection and a chain of defections will happen. A chain of punishments or reprisals may start due to TIT for TAT strategy. It can destroy the aim of strategy of keeping cooperation. To solve those issues of “not enough forgiveness” in TIT for TAT, it is possible to design strategies, for example, a TIT for two TAT or another combination of TIT and TAT to increase the amount of forgiveness in prisoners’ dilemma.

**Continuity and stability in PD and organizational change:** According to backward reasoning in repeated games at section 4.10, players start to think about last round and then apply the logic to previous ones until the first game. According to mathematical simulation, it means that if a player wants to cheat near to the end of a game, where there is no place to use of punishment strategies. The simple logic can impact on the nature of humans' behavior in change. Implication from repeated prisoners' dilemma claims that if the game of change is repeated enough, it encourages cooperation behavior among people. Real evidence show that the long term partnership decreases bad effects of PD in change programs and people have more commitment to change (Erik, 2007). The likelihood of continuation in relationships determines how people behave in such situations. For composition of groups in change management, if that is stable and expected to remain then people have intensive needs to cooperate. Hence, continuous change when people expect the change program to be continued in the future is more likely to result in cooperation rather than change that have perceived as a management fad or fast change. Fast change programs may persuade people to not cooperate because they can understand that if they resist now, they gain more because waves of change can come and go. On the other hand, if people have a perception of continuity and ongoing program of change towards improvement as the goal, year to year, they start to cooperate more because they can gain more advantages in the future rather than have short term strict resistance.

Change implementation teams are also affected by repeated games. If the group of players expects a new change agent will come and break the tacit cooperation in future, there is an increase of temptation to cheat and take short term benefits. Therefore, it is important to share the atmosphere of continuity and stability during change. This is also true about stability in the management team. When people believe that the senior management position is not stable even if he extremely supports the change, it decreases the probability of cooperating because people might gain more from not participating in current change and block it. This case is more normal in public organizations which are so sensitive to the political environment. Briefly, experimental evidence show that the amount of cooperative strategy will decrease by the fact that players see that the game has limited short runs (Telser, 2007).
Along with previous discussions about continuity, practical price wars in business have also showed that fluctuations in economical conditions will affect the nature of current PD relationship (Dixit and Nalebuff, 2008). In an economical environment where it is expected to have a crisis, people have more temptations to cheat and show non cooperative behavior during organizational change and gain as much as possible because the future is unknown. When people are not sure about their future work and economical situation, cheating can bring them larger immediate advantages. Even without profits, it hurt the sense of responsibility about change programs and brings more incentive to keep current state.

**Behavioral PD and organizational change management:** Thousands of experiments have been done on prisoners' dilemma in reality and laboratories. The most important finding is the *significance of taking a cooperative strategy*. It seems to be in contrast to what the theory proposes because the complete selfishness should dictate all people to defeat. On average, nearly half of the players select to cooperate even when they meet only once (Camerer, 2003). Players seem to ignore the logic and try to achieve benefits of mutual cooperation. According to experiments, a significant amount of players show a tendency to choose a cooperative strategy, because they know a cooperative strategy will bring more benefits, but they cannot be sure about others. What if others choose defeat? If they believe that a cooperative strategy from a rival will not be true, the game tends towards total loss. The reason behind why people act like that in this game helps to generalize game theory in change management.

Game theorists have some explanations for this action. The first point is, it seems that people have irrational behavior, but the notable factor is players think that others are irrational as well. Hence, whenever all players similarly think about more profits from cooperation, this mutual trust continues. Another explanation stands on the concept of "reciprocators"(Camerer, 1997). Players cooperate while others do the same. Reciprocating action is one of important phenomena that people apply in games. In repeated games, players start to cheat near to end of game but if people try to cheat from the first round, it reveals their nature to other player, so, in order to hide some truth for a while, they start to cooperate and gain benefits of cooperation while they both might know the deception, but at least, they can gain from this mutual deception.

Based on discussions above, if people in organizational change are aware of what cooperation will bring to them, naturally they choose cooperation and trust managers and change leaders. If people become convinced that cooperative behavior brings more advantage to them and this fact is communicated and shared in the organization, then most of the people start to cooperate rather than to exhibit short term selfishness. The significant amount of taking a cooperation strategy express that people are not going to defect rather, they initially cooperate and trust on other players if they know what the result of cooperation is. People fear the uncertainty of change outcome not
from change itself (Kohlrieser, 2005). Role of pre play communication is important here before starting the game of change. Change agents are also reciprocators, meaning they see and judge personally the level of cooperation among other change agents. Observable commitment from managers brings the sense of cooperative behavior, so other agents try to cooperate while they see this behavior from others. That is why accessibility and persistence of managers was emphasized in some literature. Change agents here, could be managers, employees, shareholders, external consultants, functional departments and generally those who affected by change and/or those who has effect on outcome of change.

**Role of sexuality in PD and change management:** Experiments of prisoners’ dilemma about how people select between two choices of strategies, "cooperate" and "defeat" shows that women are more likely to select "cooperate" with 53.7% rather men with 47.5%. When there was a group of two women that play the game of prisoners’ dilemma, cooperation rises up to 55% but when woman paired to man as players of prisoners’ dilemma game, the tendency to cooperate falls to 34.2% (Oberholzer et al, 2003). Phenomena of PD implies that the role of sex in PD games could be taken into account when managers build change groups or when managers want to analyze reasons behind conflicts.

**Role of relationship shifting in PD and change management:** According to the tendency of players to cooperate with each other, it was shown that when pairing is done in different arrangements and time, cooperation decreases (List, 2006). It means that when people must play the game with different players in different times, their tendency to exhibit a cooperative behavior will be decreased. It has great impact on organizational change. Conflicts of interests always exist between change agents but in order to have effective cooperation, we can take these facts into account. Different arrangements inside the organization might tend to less cooperation between change agents in future. Trustiness and tendency to cooperate in conflict situations decrease by repeated shifting during change program. Organizational change should keep the current organizational relations as much as possible to increase prospect of cooperation in future.

**Social Cheaters in practical PD and inside organization:** One of the problems of cooperative behavior among groups of players is free riders. It is possible for players to have temptations to withhold his contribution and hope to enjoy benefits of others' efforts. This temptation is dangerous in change programs because group work skills and effective teamwork need more contribution to group. This may happen in level of one employee when he avoids learning programs hoping on others' knowledge to contribute to the change covering his shirking. This problem will be more important in public sector organizations where the punishment strategies are harder to implement. Enterprise software's implementation often comes with departmental conflicts based on what has been mentioned about political organizations (Yongbeom et al, 2005). In order to analyze the problem of non cooperative behavior between
players, experiments of multi person dilemma in university of Texas expressed that
people have significant engagement in punishment of social cheaters (Bishop, 1986).
Punishments increase the amount of contribution in game in first round, after
punishment of social cheaters. People also are ready to punish social cheaters by their
own costs in prospect of better benefits for whole group.

Experiments about punishment action in multi person dilemma unfolded an even
greater reason. Players' brains have been imaged by PET scan while playing the game.
It revealed that players actually feel pleasure or psychological benefit from punishing
social cheaters (Hayden, 2005). This special behavior from players may be useful in
organizational change to design effective mechanisms of punishment to those who are
not cooperating or cheating, in order to achieve better goals for group as a whole. It
reveals that change agents prefer to see punishment of social cheaters and those who
are not contributing to change yet enjoy the benefits. If change in some aspects, needs
more efforts from agents and some of agents (from different level) wants to slack off,
prospect of cooperative behavior decrease among others unless they see punishment.
PD experiments express that other agents feel more satisfaction after punishment of
social cheaters.

Pre-play Communication in practical PD and change programs: Scientists,
who walk between game theory and the world of business strategy, have found
another important point in practical dilemma. In fact, cooperation is much easier
between players when they can meet regularly (Cooper et al, 1992). Players can
negotiate and agree on a compromised approach to take practical steps. According to
what was explained earlier, practical steps towards cooperation involve definition of
"what is a cooperative action" and "what is cheating" and probable punishment and
rewards. If something occurred against cooperation, they also can discuss whether it
was an inadvertent action or intentional cheat. It also works for game of change.

Regular basis of meetings and negotiations can avoid unnecessary punishments and
increase mutual understanding about the change (Milgrom and Roberts, 1990).
Change agents can know each other’s perceptions, value agendas, incentives and
choices of strategies. Employees can better understand the situation of change and
cooperative actions while managers also can transfer why they are going to make
some punishments. Choices of each change agent could be clearer, and then decisions
will be more rational towards cooperation.

5.3.3. Lessons of "battle of sexes" to make cooperation in change

Battle of sexes (BS) is another sub game that can be applied in change
management. This game like prisoners' dilemma is famous and important but the
generalization ability and mathematical solution is not as important as prisoners'
dilemma.. It reflects a situation where there are two or more Nash equilibriums in the
game. It means that players should agree on one equilibrium point, but both situations
have the characteristics of any equilibrium point (Osborne and Rubinstein, 1994).
**Formal Proposition:** A couple going to their work every day and meet each other after work. One day, they forget to determine a specific place for meeting. Usually they meet in specific restaurant (R) or in coffee shop (C). Distance between these places is high and they don’t know what place has been fixed. They both strongly prefer to see each other but woman normally prefer to meet in restaurant and man like to set meeting in coffee house. What do they ultimately do, or what is the solution of game? Preferences are ranked from 0, 1 and 2 according to their personal incentives.

<table>
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<th>C</th>
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<tr>
<td>Man</td>
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<td>C</td>
<td>1, 2</td>
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**Nash Equilibrium of game:** It is obviously one of the non-unique Nash equilibrium problems. According to Table 8, there are two points with Nash attributes for game. At those two points, strategies are tied together and are the best responses to each other. It can be seen easily from the strategic form of presentation.

**Change management proposition:** This game reflects a situation in which change agents like to cooperate but they have conflict of interests. Agents have preference over different outcomes while they both prefer some agreements to pass over disagreements. All players in a change situation prefer to have an equilibrium outcome rather non equilibrium result, but they should manage their conflicts as well, so this game appears when there are commonality and conflict. Agents know and prefer to achieve change outcome, they are aware of the importance and usefulness of specific change but meanwhile they must agree on one strategy or one nesting point to pass over the conflict.

**Behavioral BS and organizational change:** In BS games, the nature of game shows agreement about general outcome but players have different preferences concerning strategies and stage outcomes. This fact is usual in change programs when change agents agree to the necessity of change or on what should be achieved after change but they are not in agreement on strategies and exact outcomes. As discussed in the theoretical background about political organization, disagreement about change is occurring because the nature of organizational change is interdependent. Sources of power have different agendas and concerns; employees about their job security, senior managers about profitability and middle managers about their authority positions (MCallaster, 2004). Those sources of power were called change agents in the game theoretic analysis. Government is concerned about social and environmental aspects and labor unions about wages and contracts. Empirical evidence from large scale projects like enterprise system solutions reflect appearance of BS. Job definition and job recognition will be affected by change, so people have different preferences while
they all understand the urgency and total profitability of change (Besson and Rowe, 2001). Experimental evidence about "Battle of sexes" reveal some useful hints about how different agendas have to be coordinated.

Players in this game should find a "prominence" point to coordinate their expectations. A prominence point should be perceived from both sides. Thomas Schelling introduced the verbal and mathematical concept of "focal point" for the first time (Schelling, 1958). Players normally think about what others think and it makes an infinitum series of thinking about thinking. When there is possibility of convergence in one point, then mathematical series will converge to that point. Different experiments have been done to discover what can be used as a focal point and how people act to achieve a focal point. We can apply those insights in improving leads to change.

**Role of history and culture in BS and resolving change difficulties:** One of the most important key factors that converges expectations is the "common experiences". In some experimental games that has been designed based on the BS game on TV shows (Life, the game, ABC TV, 2006), a couple was shown in New York City trying to find each other without any possibility of communication. Results show that groups were succeeding because they used common history about places and memories about their habits. In one experiment in the University of Stanford, students played a game taking their choices of different cities without communication. That game had 512 equilibrium points which is very difficult for cooperation (Dixit and Nalebuff, 2008). Results show that nationality and culture helped them to create a focal point. When players have the same culture or common experience, it is easier to reach a focal point.

Focal point is more important when the change group is designed. People from same departments or from same plant that have commonalities in culture and history can reach a focal point easily and agree on one solution. Problems in change arises when managers or change leaders coming from outside the culture and history boundaries. External change implementers have more problems to gain a compromised approach. Some authors in organizational change have mentioned the role of "meaning maker" (Raelin, 2006). Practical articles also show the need of senior managers in change theories to bring them the power of sense making (Andrews, 2008). Therefore, according to game theoretic lessons, sense makers or meaning makers should be selected from those who have same culture and history of cooperation as other change agents. They can make better cooperation for change programs.

Motivations of change program should be communicated by those who have participated in common experiences of organization. This key factor is more important when traditions are highlighted in organization. According to what was explained in section 3.6, traditions are inevitably part of public organizations.
Technology driven strategies or attractive organizational changes should be implemented by change processes that have some elements of shared organizational culture. This fact implies how cultural artifacts should be designed for effective change strategy. Divisions of cultural artifacts and their role were mentioned in the theoretical part, but the concept of focal point seems to facilitate the use of cultural artifacts in change programs.

**Distinguishing ability in BS and process of change:** The reason behind any focal point is the "distinguishing ability" of focal points. Distinguishing ability is the factor which discerns some ideas by others. It is not required to be a rational or a very specialized factor, any variable that can bring a "sense of difference" is a distinguishing factor. To describe precisely, John Keynes, (famous economist), designed a game theoretical test on find how people behave in stock market (Keynes, 2006). He advertised a test that who is the most beautiful model in the world? The best model is the one who get more votes and the winner is one who voted to that model. People should think about, which is the most beautiful while they should also think what the others think about most beautiful in a parallel manner. The results was surprising, the top models are not angels or have perfect features. They are persons who have an interesting flaw that gives them a differentiated personality and a focal point. This concept also works concerning the amount of stocks that people buy in stock market. Investors take mostly amounts of 10,000 or 2500, not because it is an optimal solution; rather it’s a focal point. Those numbers are common because they make a congruence of expectations on round numbers.

Change programs also should have some elements of distinguishing ability. Employees often see change programs as management fads or "like past" events. Change initiatives should make a sense of difference. When conflicts arise between change agents, a solution that has the ability of differentiation, regardless of how much it is optimal or rational, can be applied. An application to the role of distinguishing ability could be a diametric presentation of organizational restructures instead of a formal presentation. Case studies about change management say senior managers sometimes want to impose a restructuring change about being a more flat and project oriented organization. The problem is the organizational culture which must be different especially where marketing is based on social and historical networks of each manager. People like hierarchical organizations with more sense of authority (Fernandez and shengjun, 2007).
Focal points can bring a new idea here about new structure representation in kickoff meetings. When a new structure is presented by horizontal and vertical organizational lines, it causes resistance because managers see themselves lower in horizontal line but a concept of diametric structure can achieve better consensus. This new representation of organizational structure transfers the meaning of same managerial positions. As Figure 8 illustrates, it apparently reflects the sense of same power while it wants to remove functional barriers. It can be used at the time of kickoff meetings when managers represent a diametric view about a new organizational structure at the first introduction of new structures. It helps to transfer the meaning that "we do not want to remove your power" it is just a redistribution of tasks but if senior managers present it in a classic and formal shape, it cannot send this message even though senior manager really don’t want to destroy the manager’s positions. The point is; what is the difference between perceptions on authority and power in these two figures? Does the new graph reflect two managers with same position and managerial personality?

The second organizational figure can reduce middle management resistance because it transfers the sense of keeping same position. The first one although, has the same responsibility distribution as the second one but, if the change introduced as the second one, it looks different from the previous one because it has the distinguishing ability. The first structure is not capable of carry the meaning of same power thus; it is easier to give congruence expectations to local managers towards the change philosophy. Change agents recognize that they must focus on one equilibrium because it's better than other choices anyway. Congruence of expectations or focal point is where game theory is integrated with social and psychological aspects of life. Game theory uses those concepts and tries to generalize phenomena of strategic behavior (Camerer, 1997)
5.3.4. Cooperative behavior in GT and organizational change

Game theory reflects situations in which behavior of one person affect whole of a group and the behavior of group also affect on individual behaviors. In some cases, it is not necessary to try to change all players' behaviors. If a group of people start to change their behaviors, the whole of a system will change. This fact and the logic behind it can be shown better by real cases. Here, I explain game’s theoretic analysis of group behaviors by a practical game. As discussed in section 5.1, a practical game here reveals some lessons for managing change.

Description of GT example: Traffic is the game between different players and the police. Decision of each driver affects other drivers and vice versa. Highways often have the speed limits. If nobody obeys the speed limit then a driver should not obey the limit as well. There are two reasons behind that: first, when other drivers at a high speed, then will be safer for all drivers to drive at high speed. It is dangerous to have low speed when everyone else is driving faster. Second: if others go at a high speed, the probability that a speeding driver will be caught by police is decreasing because everyone is driving at a high speed, so the driver is not distinct. The situation is presented in Figure 9. The question is how the police can decrease the amount of high speed drivers?

As it's obvious, like organizational change, here it's needed to change behaviors, but behavior of one driver is somehow related to others' behaviors. It implies the change situation. In order to analyze and represent this game figuratively, a graph has been created. The vertical axis is the payoff for each driver from a specific speed. Payoff means degree of satisfaction from each decision or what they like to do.

Figure 9: The problem of drivers' behavior and its equilibrium point. Extracted and Modified from Dixit and Nalebuff (2008).
Horizontal axis shows the percentage of drivers who obey the law of limitation (Lave, 1985).

When one driver decides to speed up, it makes it safer for others to speed up. If nobody wants to increase his speed then nobody wants to be the first "high speeder" and give “benefit” for the others when there is no reward for that action. On the other hand, if everyone speeds up, no one is willing to slow down.

According to what we see from the Figure 9, the police want to change the equilibrium point to desired state. In order to change the equilibrium, we should change line positions (self calculated payoff). Based on the introduction and percentage of drivers' who obey the limit, if a "critical mass" of drivers obeys the limit, it's enough to change other drivers' behaviors. The key point is a powerful strict enforcement with serious punishments which in short run can change behavior of enough drivers to leverage complete obedience (Dixit and Nalebuff, 2008). When equilibrium moved, police can go back to normal control because compliance behavior is "self-sustaining". Strategic advice from game theoretic analysis, suggest that a short but significant punishment is more effective than a long term medium control and enforcement.

The relation between equilibrium point and critical mass suggests use of critical mass and punishments in organizational change. A theoretical overview on group behavior and critical mass is done in theoretical background. Without going to deep in review of change literature, the role of critical mass also has been mentioned in several publications, (Lou et al, 2000; Poole and Van de Ven, 2004). Here, based on game theoretic insights, the main effective concept is equilibrium point. If we change the equilibrium point in organizational change, then most of people will change their behaviors. Another important issue refers to the characteristics of "equilibrium". Equilibrium is self-sustaining, thus the new situation will be kept. In changes where we have quality control, implementation of TQM or ERP change programs, permanent control and punishment is costly. Any supervision has negative effect on monetary and non monetary expenses. On the other hand, moderated long term enforcement is also costly and not effective.

When overall change in behavior is possible by movement of equilibrium and equilibrium can be moved by momentum of enough change agents, it is possible to change general behavior and integrate new behavior in organizational culture. The main problem to analyze in organizational change is how to define a graph like introduced in the example. How payoff functions have to be created? To answer this question, we should consider that there is no need for an accurate graph in organizational change; of course the speed control is not very precise. A relative schematic of payoff functions seems to be possible by experienced managers. The concept of equilibrium and the game theoretic nature of critical mass are remarkable.
5.3.5. Unwanted cooperation in organizational change

Like the fact that every one's behavior has impact on group behavior which as discussed in section 5.3.4, the equilibrium point can be a bad equilibrium from the management perspective. Some real cases in policy and technology transfer, shows that sometimes a historical force can block a group into bad equilibrium. Like the nature of equilibrium in speed control, some actions in behavior can push a group into a slippery way by starting a chain of action and reactions that reinforce each other towards a bad equilibrium. People in these cases are mutually reinforcing their expectations towards an equilibrium that is not good. Standards and norms are not completely technical or optimum solutions, rather they could be equilibriums made by behavioral games (Camerer, 2003). In contrast to a conventional economic, there is not an invisible hand to coordinate selfish behaviors in a way that lead to a good result for all group members. It implies that there is a need to intensify some actions either by punishment or reward to change the movement direction of equilibrium. Otherwise, equilibrium may go into an extreme position.

A social example of racial distribution can bring same effects in organizational change. Experiments have shown that if the proportion of black or white people rises above a critical point, then it will increase to nearly 100 percent and vice versa. As presented in Figure 10, the percentage of one category determines the probability that the new entrance would be from same category. In dynamic mode, again the new entrance will increase the percentage and next entrance. Two factors reinforce each other to nest in one of the equilibriums at corners. After a critical point, movement

![Figure 10](image_url) Figure 10 : Figure shows the problem of segregation and the concept of tipping point, Guided by Schelling (1971)

quickly increases towards one of equilibriums. Schelling calls this concept as "tipping point" in dynamic models of segregation (Schelling, 1971).
Tipping forces goes until the mix of a new entrance becomes the same as the mix in the current state. That only occurs when the population becomes homogeneous at the end of the graph. All group members in this game get worse case because the middle point is not stable. Equilibrium is the stable point and the middle point in this game is not stable because there is no similar tendency towards the middle even if people like to live in a racially distributed area. The primary idea of Schelling in game theory was applied in many different cases. It has been applied in organizational change in order to model commitment (Shapiro, 2003).

The evidence from racial segregation implies the need of effective management of change by considering every step of organizational change. A package of change with limited time of implementation is sometimes more sensible than small steps because change agents can understand reforms in one package, so everyone know where is it going and what is the final step. Small series of change actions seems more attractive but there is a risk of one undesired action tending to an unfavorable series of results. It happens mostly in "total solution" changes. New management systems have impact on all information channels and processes. If it is supposed to be implemented in many small steps to adopt the organization, there is a risk of swerving towards equilibrium by small mistakes and occurrences of a series of bad actions and reactions against a defined outcome. It means that "total system solutions" might be best to be implemented in limited periods rather than doing a long period of change. Of course it is just a game theoretic perspective. Managers should take into account its suggestions and risks, then try to decide based on all factors about an appropriate change strategy.

### 5.4. Group dynamic problems in change and GT modeling

Establishing groups to implement change is much discussed in literature. Group members might be people from different departments that engaged in a new product development project or inside one functional department. Groups can also be combined from employees, engineers and first line managers who make independent production groups. Apart from who constitute a group, members are change agents in organizational change. Change could be the implementation of a new technical system or a new management structure or a project in a small location or in the whole the organization and it might be possible to have different nested groups. However, when the outcome of change or rewards of change of any kind (monetary or nonmonetary) is determined for the group’s work, it is possible to consider free rider problems. Simply, people might have a temptation to work less and enjoy the change benefits. This problem can be modeled at the level of single persons or departments or companies. Cooperation in change needs effective commitment and hard working of all change agents.

Organizational change often comes with calculation of people benefits. Some authors believe that if we understand the outcomes expected by people, we understand their behavior. "Change the outcome people expect, change their behavior" (Latham,
2003). Group members estimate their outcome and decide upon the amount of effort to provide. Here, I want to design a game theoretic model for group works and try to solve it. Outcome can be translated into numbers either by monetary outcome or by utility function of preferences. It is also possible to quantify people’s satisfaction by mathematical numbers. AHP (Analytic Hierarchy Process) techniques help to express qualitative data into quantitative information (Bhushan and Rai, 2004). Explanation of AHP approach is not the aim of this thesis so, I only mention that AHP techniques can be applied here to quantify outcomes or express it in math language.

In this session, in order to get close to the mathematical part of game theory and equilibrium solutions, I want to model a cooperation problem with game theory and then analyze the results. I designed a two player model to simplify the problem. Of course, solving a game with more players require mathematical software.

**Description of model:** Two players are assumed to work in a change project. The advantage of change or outcome is affected by each player's effort. Let us assume that the payoff function is: \( P = 4(x + y - cxy) \), inferred from the general function of cooperation. This general function is an example of modeling a group project (Dutta, 1999). \( x \) represents amount of effort (It can refer to expense, used recourses, and consumed time, quantitative amount of effort or discrete level of cooperation) from player 1 and \( y \) for player 2. \( c \) is constant variable between \([0,1/4]\) and represents a degree of complimentary functionality. The cost of group work for player 1 to do effort level of \( x \) is equal to \( x^2 \) and for player 2 is \( y^2 \) while \( x,y \) belong to \([0,4]\). the function of cost and set of strategies are just examples to show the model.

**Note:** The nature of internal change groups is in such a way that often they cannot sign a contract for their cooperation and normally they both gain half of benefits if there are two players.

Strategic form of this game is:

Set of strategies: \( S_1 = [0,4] \) while \( x, y \in S_1 \)

Payoff function for each player is profit minus costs so:

\[
\begin{align*}
t_1 (x,y) &= \frac{P}{2} - x^2 = 2 \times (x + y - cxy) - x^2 \quad \text{payoff for player 1} \\
t_2 (x,y) &= \frac{P}{2} - y^2 = 2 \times (x + y - cxy) - y^2 \quad \text{payoff for player 2}
\end{align*}
\]

According to the definition of Nash equilibrium in the theoretical background, equilibrium occurs when the best response of each player cross each other. In order to find the best response functions, each player has a belief about other player, and then tries to maximize his expected payoff, corresponding to his expectations about what other player do. Expected payoffs for each player are based on expected effort of rival
or $\bar{Y}$ (Expected value of variable $y$) or $E(y)$. For example, expected payoff for player 1 is like this:

$$u_1(x, \bar{y}) = 2 \times (x + \bar{y} - cxy) - x^2$$

and for player 2 is:

$$u_2(\bar{x}, y) = 2 \times (\bar{x} + y - c\bar{x}y) - y^2$$

In order to find function of best responses, I should differentiate the mentioned function of expected payoff. It reveals the function of best response, where the functions equal to 0.

$$\frac{d u_1(x,y)}{dx} = 2 + 2c\bar{y} - 2x = 0 \rightarrow B_1(\bar{y}) = 1 + c\bar{y}$$

And with same calculation; $B_2(\bar{x}) = 1 + c\bar{x}$

Now, it is possible to find equilibrium of games by two ways, IEDS method that introduced in section 4.8 and second, by function of best response. Second way is easier so, I solve two function simultaneously in one equation to find cross points or amount of variables $x$ and $y$. Before going to calculations, it might be useful to draw diagram of game and functions. It helps to understand what should be done and how. The Figure 11 brings a figurative interpretation about what players are trying to do and where the equilibrium is.

![Figure 11](image-url)

Figure 11: Figure shows the functions of best responses and their cross point that represents the Nash point.
Game of change; a game theoretic approach to organizational change

\[ B_1(y^*) = x^* \]
\[ B_2(x^*) = y^* \]

\( x^* \) and \( y^* \) are amounts of variables in crossed point or in equilibrium point, Derived from crossed functions.

Based on calculations above, we can also find the payoffs for each player at equilibrium point:

\[ u_i \left( \frac{1}{1+c}, \frac{1}{1-c} \right) = \frac{4-2c}{(1-c)^2} - \frac{1}{(1-c)^2} = \frac{3-2c}{(1-2c)^2} \quad i=1,2 \]

\[ \frac{3-2c}{(1-2c)^2} \] is the amount of payoff for each player. Coefficient C can be defined according to different situations. These results help us to understand what the amount of efforts from each player is, and also what would be the outcome of change for them after a group work given their efforts level. Result is for equilibrium situation, means their temptation to work will come together in a stable condition. The extracted amount of payoff and efforts of change agents, were calculated for a model of a group situation where there is a problem of free riders and selfish benefits of each person that wants to have a higher pay off with less work and more advantage.

An interesting question would be; how much is the optimum of payoff for players when they can cooperate rather completely? The equilibrium amount represents players’ strategies in an equilibrium situation but of course they can gain more by cooperative work. Players and managers may want to estimate how much the outcome of a cooperative work would be. The answer shows the best possible outcome of their work but only if they omit selfishness and try to cooperate with each other in the game of change. Now, I want to calculate the optimum solution. I should find an answer that can maximize the payoff function, \( u \).

\[ \max u = \max [4(x + y + cxy) - x^2 - y^2] \]

\[ \frac{du}{dx} = 4 + 4cy - 2x = 0 \quad \Rightarrow \quad \hat{x} = \frac{2}{1-2c} \]
\[ \frac{du}{dy} = 4 + 4cx - 2y = 0 \quad \Rightarrow \quad \hat{y} = \frac{2}{1-2c} \]

\( \hat{x} \) and \( \hat{y} \) are the maximum possible payoff from game, if they cooperate.

Comparison between results of optimum solution and equilibrium solution prove the idea about cooperation and coordination.

\( \hat{x} = \frac{2}{1-2c} > x^* = \frac{1}{1-c} \) and \( \hat{y} = \frac{2}{1-2c} > y^* = \frac{1}{1-c} \)
A comparison between the results of cooperative and selfish behavior represents that cooperation lead to better results for both players. Cooperation among players needs effective commitment and strategies that have been discussed after prisoner's dilemma and battle of sexes, players can see that the amount of outcome is increased by cooperation and not competition.

5.5. Incentive rewards (payoff) in change management

Payoffs or incentive rewards are one of the most important tools for managing change. The question "what's in it for me?" is one of the issues that should be addressed before starting change programs (Latham, 2003). Managers who deal with change challenges often are supposed to gain considerable rewards for their efforts. If people do not see any benefits for their hard efforts, they might lose their commitment to change goals. Rewarding does not necessarily mean monetary rewards. Of course one of important payoffs is money but some authors define other payoff methods also. Relationship, opportunities and pride are some non monetary rewards (MCallaster, 2004). Practical change programs have proved that "Giving incentives to employees helps to stimulate and reinforce the positive behaviors and culture needed" (Wong, 2005). For some change agents, development of their relationship is very important like the role of pairs in prisoners' dilemma. Opportunities for improvement and a sense of pride being respected by organization and are also remarkable issues to design reward approach.

Change agents like a senior manager, employee, head of department or different layers of management have so many things to deal with in change program. Capacities, employees, social issues, resistances and so on, but other change agents like share holders may just see the profitability of change. Shareholders for example see the success only in terms of KPIs. (key performance indicators) and those KPIs are often interpreted as profitability in net profit diagrams. The conflicts over preferences of shareholders and managers lead to difficulties in making rewards. A manager who gives rewards should have a reason to give those rewards and need to interpret them in language of organizational profitability.

As discussed in previous examples in section 5.4, from a game theoretic view, utility function are not necessarily a monetary function. Payoffs could have any meaning like level of effort, cost, time, and opportunities to go to another job. For game theoretic analysis, it is important to assign numbers to utility function. In this session, I draw on game theoretic analysis about incentive rewards based on what was introduced in literature about "principal-agent" game (Dutta, 1999). Before going to design a game for incentive rewards, it is useful to introduce the term "moral hazard" and its impact on change management.
5.5.1. Moral hazard in change management

The concept of moral hazard refers to an insurance situation where the insurance coverage leads to less care about insured object. People who have insurance confidence are careless about their insured objects because they are sure about recovery. The main lesson of moral hazard for managing change is, what perceived good for the agent is not necessarily suitable for the manager (principal) and the manager cannot always control what the agent does. When in a game, the principal cannot simply force an agent to act upon the principal’s interest. This game has the element of moral hazard. The reasons behind this fact is that a manager cannot dictate to an agent what his wants are; firstly it is not possible to monitor agents actions and behaviors at all times so agents behaviors may not be observed. Secondly; even if manager can observe an undesired behavior from agent, it is often not possible for him to take a legal action. (For instance, bringing contract to court.)

Because of moral hazard, the manager or principal should prepare a schema that can persuade agents to act in way that the manager prefers. How can the manager design an effective reward method that induces his agents to do as he wishes, considering the problem of moral hazard? In order to answer this question, game theory can help us to model a conflict between change agents like between a manager and employee and find the effective reward strategy. Here, game theory can help to analyze the rewarding problem and give some useful managerial lessons from mathematical results.

Modeling of situation: I modeled a situation where there are two players, one manager and one agent. Manager and employee can take two strategies and there are three consequences for each action of employee. The situation is presented in Figure 12.

Manager decides about compensation solutions to offer to the employee (this also can be between owners of company and manager). Change agent or employee sees the manager’s decision and thinks that he should use high effort or low effort, wh or wl. The amount of effort like the previous model in group dynamics could be a decision about which project has to be selected or even the decision to find another job. Moreover, it is important to consider that employee decides after manager’s decision and also his choice of decision is not clear and observable to the manager. In fact, the choice of employee has impact on profit of company. Each decision of players in this model has effect on the level of profitability. I assume that there are three level of profits; Good, Moderate and Bad. Another important note is that in real world there is not a direct relation between each level of effort and each level of profitability. Profits of company could occur because of reasons other than the employee’s work. Environmental effects are also important, so there is uncertainty over the level of achieved profits.
The uncertainty in this model is treated as the probability distribution of the level of profits. In addition to the probability distribution, in some game theoretic literature the reality is defined as role of nature. It means that in addition to the employee’s chosen strategy, nature determines the profitability of the company. Based on this incompleteness, for example after company reaches profit level of G, the manager cannot surely say that it is because of a specific employee effort but finally he judges according to released profit level.

The manager pays the reward of Rg when he sees the profit level of G, Rm for M and Rb for B. According to that, net profits for manager are G-Rg, M-rb and B-Rb. For the employee side, if he is paid at Rg, his satisfaction is according to his utility from that reward or u(Rg). If it's assumed that there is utility and disutility, disutility or dissatisfaction of the employee, that is dH, when he spends amount of Wh for his work. It reflects that hard work has the disutility of dH against his utility from the revealed compensation package. If efforts are harder, disutility is also bigger.

One question for change modeling is: which function can I assign as utility function in order to model the behavior of employee and manager?

Figure 12: Game tree of the problem of incentive rewards. Manager and employee decide about the compensation package and level of efforts regularly.
Types of behavior between change agents: According to game theoretic literature there are three different behaviors for agents; risk taking, risk averse and neutral to risk. Behavior of the employee or agent in our model is assumed to be risk averse and following a concave increasing function. It means that the employee prefers to have 100 Kr for sure rather than take the risk that a gamble with same chance to lose or win another 100. In that sense, payoff is initially important, not the additional amount of 100 Kr. Figure 13 represents different functions of behaviors in game theory.

Assumptions in modeling change rewards: Here, the function of utility based on types of behavior, assumed as, \( u(w) = 2\sqrt{w} \). \( dH = 10, dL = 0 \) and profits are: \( G=200, M=100 \) and \( B=50 \). Probability distribution for each profit level when the employee works hard is \( G=0.6, M=0.3 \) and \( B=0.1 \) and the probability when the employee has low effort is the opposite of high working. I should note that these numbers are just examples to show how it works. Any specific situation can have its characteristics that will be explained later in generalization of model.

Based on our game tree, three kind of possible reward systems will be analyzed and inferred lessons will be discussed.

Pure salary based schema for change agents: It is possible to have a fix salary for agents before and after the change. It means that new tasks and responsibilities that come after change do not have effect on his salary. We know that change often have new requirements to deal with. At least employee needs to effectively participate in learning programs. In this case we have, \( Rg=Rm=Rb= R \) for payoff level of \( R \). It is clear that the payoff or reward for employee should be \( u(R) - dH \) when he works hard and \( u(R) - dL \), if he works in a low level of effort. From types of behavior, \( dH \) is bigger than \( dL \), so it is natural that employee will choose \( Wl \) or work in low level between two choices because the salary is not dependent on profit level and change.
outcome. Change does not bring anything to him so it could be normal to select what he likes rather than to do what is good for manager.

**Pure risky schema for change agents:** It also can be called franchise schema. This case is completely opposite of pure salary base. In previous method, manager takes the whole risk of change outcome and in this case, employee bears the risk of profitability. It is possible to imagine that employee is always in risk of punishment unless the outcome satisfies the manager. In other words, manager sees employees' new tasks as his normal responsibility and nothing special. The employee should adapt himself for each decision otherwise he will be punished. Punishment can be interpreted as fear of firing. There is always a certain amount of probability for firing (punishment) whether the company gets high profit or bad profit. This management style treats employee as a slave that needs the manager in any case. This is occurring when the economy is not in balance between applying and demand of workforce.

In order to model this risky situation of employee in language of game theory, I assume that the interpretation is like employee should pay a certain amount of fee, \( r \), to manager regardless of profit level. It is not far from reality because in some wage contracts, employee should deposit a remarkable amount of money (check or pledge). Manager can fire him whenever he wants and if any problem occurs, the manager shows the deposit.

Based on assumed probability distribution, if employee works hard, his payoff is \( u(\text{Rg}) \) or \( u(\text{G-r}) \) with the probability of 0.6 and \( u(\text{M-r}) \) with the probability of 0.3 and \( u(\text{B-r}) \) with 0.1. According to this modeling the expected payoff for employee for each action he takes is:

Payoff if Wh; \([0.6 \times u(\text{G} - r)] + [0.3 \times u(\text{M} - r)] + [0.1 \times u(\text{B} - r)] - dH\)

And in low working, Wl, \([0.1 \times u(\text{G} - r)] + [0.3 \times u(\text{M} - r)] + [0.6 \times u(\text{B} - r)] - dL\)

After solving those equations together with given assumptions, the result would be the employee wants to work hard, if and only if:

\[\sqrt{200 - r} - \sqrt{50 - r} \geq 10\]

Note: in my simple model it is obvious that the maximum amount that manager can charge the employee are 50 because it is the same as B profit level. So at maximum level the equation is:

\[\sqrt{150} \geq 10\]

The managerial lesson for change manager is that the employee with higher probability will work hard even if it is more difficult because of the equations, the probability that employee selects \( G-r \) is greater than \( B-r \), but of course it depends on the risk amount or \( r \).
**Salary based reward with bonus for change outcome:** In this strategy in change, manager can induce the employee to act as a change program need by a fixed wage and bonus for his efforts. In this manner, manager and employee share the risk of change with each other. As I explained earlier, the first and second method places the all the risk of the manager or employee. In order to model this situation, manager can give a fix salary as Rb and if the manager sees the higher profit levels, G or M, then he pay Rg - Rb or Rm – Rb as bonus.

Based on the model, if employee work hard or Wh then his payoff is \( u(Rg) - dH \) with probability of 0.6 and with probability of 0.1, it could be \( u(Rb) - dH \) and with probability of 0.3 it is equal to \( u(Rm) - dH \). The expected profit for change agent is:

\[
[0.6 \times u(Rg)] + [0.3 \times u(Rm)] + [0.1 \times u(Rb)] - dH
\]

And if the employee or another change agent that was supposed to get the reward decides to work in low level, his expected payoff would be:

\[
[0.1 \times u(Rg)] + [0.3 \times u(Rm)] + [0.6 \times u(Rb)] - dL
\]

According to the two equations about the employee payoff, the employee will decide to work in high level of effort, if and only if:

\[
0.5 \times [u(Rg) - u(Rb)] \geq dH - dL
\]

**Effort base reward for change agents:** In this schema, it is assumed that there is no moral hazard in change situations. It reflects that managers see how employees are really working and pay them at their level of efforts. It means that employees efforts and performance measurement is observable and payoffs are set from the direct relation of efforts to wage. Based on rewards level of Rh and Rl, the employee is willing to work hard if and only if:

\[
u(Rh) - dH \geq u(Rl) - dL
\]

**Optimum reward system of model:** In order to have a game theoretic perspective on problem of rewards in change management, it is better to make two categories; change nature that involve moral hazard and situations without the moral hazard. It is because moral hazard will have considerable impact on social situations.

First, in situation without moral hazard:

Expected net-profit of manager or company if employee work hard, Wh:

\[
(0.6 \times G) + (0.3 \times M) + (0.1 \times B) - Rh
\]

And if employee decides to work at low efforts, Wl then the manager profit is:

\[
(0.1 \times G) + (0.3 \times M) + (0.6 \times B) - Rl
\]

According to those equations, manager or company or shareholders or any principal want to give bonus for higher efforts but if and only if:

\[
0.5 \times (G - B) \geq Rh - Rl
\]
Results: If I put the assumed numbers in model, the results would be the expected profit of company will be 130 with bonus model. The amount of bonus is 25 and the increase in profit in model of bonus would be 75 comparing to a salary base schema.

The results have some practical lessons. Manager should think about two important factors when he wants to decide to offer a bonus or not; first, how is the behavior of employee in terms of tendency to hard working? It shows itself in $\Delta H - \Delta L$. Another factor is how the bonus affects profit increase. It means how great is $G-B$? According to last equation, when bonus required is smaller while its impact is greater, there is more willingness to have a system of fix salary and bonus as an optimal system. It means that bonus is good but depends on its marginal effect. If the related effect of bonus is not observable like change outcomes in nonprofit organizations and state organizations or if the change needs high amount of bonuses, then the mixed system is less optimal.

Second, in change situations with moral hazard: Between the two models of pure fixed salary before and after change and full risk for employee, it is clear that pure salary is better for manager because the maximum amount for franchise and for manager is 50 and in fixed salary, the net expected profit of manager is 80. What happens if the employee or implementation agency wants to work hard?

The expected Net profit for company if they work hard is:

$$[0.6 \times (G - Rg)] + [0.3 \times (M - Rm)] + [0.1 \times (B - Rb)]$$

And the Net expected profit when they decide to work in low efforts:

$$[0.1 \times (G - Rg)] + [0.3 \times (M - Rm)] + [0.6 \times (B - Rb)]$$

Based on two equations, manager can pay the bonus of $Rg-Rb$ if and only if:

$$G - B \geq Rg - Rb$$

Results: given the numbers about model, the net expected profit of manager would be 95 and the required bonus is 100.

Two considerations of management about whether he pays the bonus or has the fixed salary are the same as in case with no moral hazard. Based on theoretical background about dynamic games and equilibrium, manager exactly pays the amount of bonus when the employee is indifferent between working hard or low. It means that the optimal bonus is:

$$0.5 \times [u(Rg) - u(Rb)] = \Delta H - \Delta L$$

Conclusions of the proposed model of incentives: If we believe the role of payoffs for employees and the role change outcome in change of behavior, the next step is how to design an optimal reward schema that persuades people to do as company wants? The effect of moral hazard also should be considered. Results of a simple model shows that the expected profit of manager is lower when there is moral...
hazard and the amount of required bonus is increasing when there is problem of moral hazard. This result proves the idea of fair, effective and a consensus based performance measurement system that is emphasized in change management literature. Many scholars believe that change goals have to be aligned with a good performance measurement system for employees to prevent conflicts and have better commitment. Moral hazard is appearing when there is no effective observability in employee actions.

Another conclusion from this model is the importance of bonus on higher efforts. Results show that bonus has positive impact on payoff of the employee and the profit of the company. It also reveals that higher change outcome implies higher bonuses. It means that higher profits implies that higher bonus should be paid so that the manager is not always expecting the employee to do as much as possible and at the highest level of efforts, rather manager may be willing to accept a moderate action from employee but with lower wages.

It is simply possible to represent that in a moderate level of profit (moderate outcome from change), it is uncertain for manager to distinct whether employee exerted hard efforts or not. For example in our model, if the probability of moderate successfulness be less than 0.3, both G and M level of profits can be assumed with hard work of employees. This uncertainty can motivate definition of a ratio for each profit level that determine how it aligned to higher efforts but still there will be uncertainty about what the employee (or any change agent that was supposed to take actions) actually did.

**Generalization ability of the model**: It is possible to extend the model and add more modification to fit in specific situations. In reality the employee or one change agent can do more action than three. The compensation packages also can be more than two. The consequences of each action also can be more with other interpretations. All generalizations are possible but the logic of need for bonus and conditions of optimal bonus would be the same. So, the conclusions can be applied even with more actions and consequences. Of course calculations for more actions and rewards packages are not possible by hand and needs game theoretic software

### 5.6. Proposed framework of GT applications in organizational change

In order to conclude the results of this research and illuminate the game theoretic approach in organizational change, an instructive frame work is proposed in Figure 14. The framework represents the main suggested categories of game theoretic applications in managing change, the problem areas of organizational change that have been identified during this research and the instrumental core of game theoretic analysis to solve identified problems. Moreover, this instructive framework was designed in such a way that it presents the relations of those parts and the mechanisms
that support using game theory in managing change. Generally, it provides a structure for game theoretic analysis in some issues of organizational change and suggests future research about the applications of game theory in organizational change.

**Main context of framework:** As the framework illustrates, the biggest circle represents the main categories of suggested possible game theoretic applications. It involves three general functionalities of game theory in relations to organizational change. They are; the use of game theory as analytical tool to interpret change situations, its applicability in strategic formulation and giving managerial advices and the equilibrium analysis to calculate equilibrium points (concrete solutions to specific situations). All three fields have been used during the analysis to show solutions in all three identified problem areas. In each problem area, it was tried to give game theoretic interpretations for change situation, represent abstract advice to cooperate change agents and the concept of equilibrium has been applied to clarify the outcome of change. However, the problem of group dynamics was more focused on equilibrium analysis. A detailed discussion about those three fields of applications was performed in chapter 4 as a conclusion of theoretical framework of game theory.

**Problem areas of managing change:** Three main problematic areas of organizational change that are suitable for game theoretic analysis are presented in turning mood. Those areas are problems that were identified in regard to theoretical
background of organizational change and the potentials of game theory to suggest solutions. Those identified problems with related motivations were discussed in this chapter. The arrows in figure and the turning mood of problems represent that all three applications of game theory as the context of framework were utilized in each problem area to create solutions. It is also important to emphasize that those problems have relations to each other. It means that they are not totally independent and it is better to see them in a more interdependent way.

**Instrumental core of the framework:** The instrumental core is the mechanisms suggested to perform game theoretic analysis in organizational change. Sub games, practical games, specific modeling and lessons of behavioral game theory are tools to find solutions in identified change problems. Discussions about each method have been done in the beginning of chapter five but here it is important to consider their interlinked structure. As figure presents, they are related to each other and are not different methods to find a solution. Behavioral studies of games reinforce and lead the managerial advice from sub games and practical games and also create a direction for empirical studies in specific modeling. Each specific model (new model) that is derived by game theory has to be tested by empirically grounded research that has been guided by behavioral studies of games.

All three elements of framework are interconnected which means that whilst the identified problem domains are generally solvable by essential functionalities of game theory, the solutions were prepared by the four mechanisms as instrumental core of the framework.

The proposed framework is just based on finding of this research so it means that it provides the starting point for further research. Obviously, it could be possible to define more problems than those this thesis identified. The functionalities of games theory and mechanisms to bring those applications are also capable of being extended and improved. Future efforts may tend to change the identified problems either by introducing new areas or merging some problem domains.
6. Chapter six: Discussions and conclusion

So far, it has been discussed that "why" game theory relates to organizational change management and "how" it is possible to use game theory in change management. In order to have a credible investigation about possible applications of game theory, the limitations and problematic issues should also be addressed. This chapter contains the main possible problems and limitations of the use of game theory in change management. Criticisms and doubts about application of game theory in other fields of knowledge which are close to its applications in organizational change management have been analyzed here. After discussion about limitations and difficulties, a comprehensive conclusion will be presented based on analysis and results by proposing a framework towards game theoretic applications in change management.

6.1. Difficulties of GT applications in change management

Level of rationality: One of main doubts about game theory usefulness is rationality of players. Some authors addressed those doubts that claim, applications of game theory need too much rationality among players that is not always available (Osborn, 2003). People in reality, do not decide based on perfect rationality or rational reasoning. Humans are a mix of altruism, fairness, and emotional actions. However, this argument is not so important because as discussed in theoretical background, not all of games need a lot of rationality. Level of rationality is not so high in many real games like those mentioned in this research. The other point is, as explained previously, sometimes there is dominant strategy that does not need the opponent to be rational. If there is a dominant strategy, we should act on it regardless of what other players think.

Another issue about rationality is if a player should just have the common knowledge or mutual understanding about other players. This term has been explained in theoretical part and is used in analysis. It says that a player should put himself in the others shoes (brains) so that he is aware what they want to choose. In means players should merely think about how others are thinking, regardless of whether they are rational or not. Decisions may come from emotional actions or altruism or any other basis, but game theory deals with outcome of value agendas not why they appear.

In the theoretical part, it has been mentioned that there is a learning process and communication during the game. It express that players gain more knowledge during ongoing games and learn how they should act and react towards equilibrium. Equilibrium point might even be achieved by non game theoretic strategies. In biology, scholars believe that equilibrium appears naturally. Accumulated knowledge of problems during organizational change and training programs for managers facilitate the use of game theory when they see the results over time. The role of pre
play communication in the analysis chapter also revealed that if people meet each other, they can agree either on equilibrium strategies or converge their expectations.

**Hardness of game theory:** Game theoretic modeling seems to be hard and complicated from managerial perspective. In some literature it is mentioned that game theory is difficult and hard to use because it needs deep knowledge in mathematics, optimization and operation research. When the number of players is more than two or three it becomes so difficult to analyze and find equilibrium. Game theoretic analysis needs change from the qualitative data into the quantitative one. On the other hand, behaviors and change outcome should be expressed in the language of functions that may not always be possible. How can managers or experts define a suitable function for payoffs?

This might be true in some cases because the game tree and calculation becomes more complicated especially when we have uncertainty and probability over choices. The mathematical prerequisite is sometimes heavy, so it is not possible to be used by managers. However, for complex games with many players we can use software packages. Computerized algorithms help to do analysis and find results. In chapter five, I introduced three main categories of game theoretic applications. Chopstick problem arises only in the third category. Strategic formulation and interpretive applications do not seem to be complicated. On the other hand, models can be in simple analysis to elicit managerial conclusions and then be generalized to find accurate results.

About the functions, as expressed in proposed models, they are general functions of payoff and effort. The main point is the functions should reflect fundamental characteristics as in the session about incentive rewards. In that case, it should show the risk aversion behavior. Constant variables of the model and other issues about precise numbers are not determinative because the model is versatile if it has the necessary characteristics.

**Problem of testability:** This problem especially arises in the third category of game theoretic applications. New models that are derived from game theory assumptions are mostly not capable of being tested. Sub games or practical cases are those that were tested over time and there is accumulated knowledge about them, but new game modeling is more problematic in that sense. Social situations have some inherent "hidden information" that doesn't show themselves in formal modeling. This hidden information only will be unfolded in real cases or in practical modeling. The behavioral game theory as an emerging division that helps to cover the issue of testability to some extent, but the lack of testing variables still remains.

**Easy explanation versus difficult analysis:** With economical models and theory of rational choice as background of game theory, it mostly relies on simple and direct relation of preferences and actions. There are criticisms that people are not very predictable, so even if you understand their preferences, there is no guarantee that
they will behave as we expect in social interactions. Game theory easily assumes a
direct relation between preferences and actions; while people are a mixture of rational
preferences, accidental emotionally reactions, stochastic behavior and generally
unpredictable strategies. Modeling of those non rational behaviors is too difficult
because they are unknown. An analysis which is based on system dynamics and
nested loops of casual relations is needed to discover the outcome of the whole
system.

According to what is discussed about behavioral game theory and what has been
proposed in change process; behavioral game theory wants to generalize social
situations and take altruism, fairness, emotionality and stochastic behavior into
account. On the other hand, theory of "mixed strategies" and "mixed Nash
equilibrium" are based on stochastic behavior. Discussion about choice and chance is
one of important game divisions where we need more development.

This issue also arises when general principles come up against local facts. Even in
behavioral game theory, there are some general rules about behavior that may not be
verified in specific contexts. Cultural issues and social norms bring other assumptions
into account. It means that managers or other change agents that use game theoretic
reasoning should start with general principles and try to find exceptions in their
context.

Considering to all doubts and criticisms over game theory applications, the general
conclusion of this research comes below.

6.2. Conclusion

A good statement about game theoretic applications helps to conclude all
discussions so far:

"In the last 20 years, the notion of Nash equilibrium has become a required part of
the tool kit for economists and other social and behavioral scientists…. There have
been modifications, generalization and refinements but the basic equilibrium analysis
is the place to begin (and sometimes end) the analysis of strategic interactions" (Holt
and Roth, 2004)

The elicited results of all literature review and proposed game theoretic
applications address the main question of this thesis: "if organizational change
problems can be solved by game theory?" Main categories of game theoretic
applications in organizational change as well as the instructive framework about how
game theory can be used in change management were presented during chapter 5.
According to the proposed framework in chapter 5, Figure 14, the problem of
cooperation and coalition, group dynamic difficulties and the problem of incentives
and rewards are such problem areas that game theory can be applied in. The main
functionalities of game theory are; to perform the equilibrium analysis, strategic
formulating and giving abstract advice and too interpret and describe change
situations as an analytical tool. The mechanisms that game theory can utilize to achieve solutions were also represented as the instrumental core of the framework in Figure 14. Those mechanisms are; sub games, practical games, behavioral studies and specific modeling.

Game theoretic models provide also a learning effect. Ambiguous and verbal explanations about requirements from change agents are not enough to encourage them to cooperate. Game models make a sense of "game" while they can bring a tangible cognition about what players gain. Simple numbers and diagrams of game analysis seem to have considerable vim to send the message of "desired cooperation" instead of "coercive cooperation". People change their behaviors when their outcome changes, so game models can help us to have a better exposure of how outcomes are supposed to change.

From a managerial perspective, my conclusion is to start with the game theoretic reasoning or Nash equilibrium analysis and then think about why and how it might differ from the game predictions. Lessons from behavioral game theory help to generalize what the theory claims. In practical manner, game theory can be a part of the management analytical toolbox to make a package of practical advice but not the whole of that. It’s interpretive and descriptive capability as well as the strategic formulation and the change modeling methods can contribute to knowledge of change managers to create new ideas about conflicts and coalitions.

Change managers can integrate their knowledge and perspectives about content and process of change with game theoretic insights. Game theory brings a fruitful source of ideas, then, it’s the art of a manager to utilize it in practice. Success in real games comes from the synthesis of the science of game theory with the art of playing the game. Equilibrium analysis gives a good basis for strategic analysis and offers a methodical thinking about games while other factors should not to be neglected.
7. References


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Game of change; a game theoretic approach to organizational change


