

## МЕТОДЫ И ИНСТРУМЕНТЫ УПРАВЛЕНИЯ ПРОЕКТОМ

# Использование теории игр для управления стейкхолдерами в малых проектах

## Game Theory Approach to Stakeholder Management in Small-Scaled Projects

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**Аннотация**

Принципы теории игр стабильно пользовались спросом как у ученых, занятых моделированием человеческого поведения, так и у практиков, стремящихся построить беспроблемную стратегию в определенных ситуациях и различных областях жизнедеятельности. Мостом между идеями, где первые встречаются вторых, можно считать проектный менеджмент, который одновременно содержит в себе множество актуальных научных проблем и способен обеспечить конкурентное преимущество в долгосрочной перспективе. Однако чтобы воспользоваться достоинствами проектного управления в полной мере, стоит уделить особое внимание крепким взаимоотношениям с ключевыми стейкхолдерами. Теория игр предлагает необходимый инструментарий, которому по силам предсказывать действия заинтересованных сторон, а также создавать и поддерживать эффективный коммуникационный поток в организации.

Целью научного исследования является заполнение пробела между возможностями применения теории игр и нынешними концептами проектного менеджмента, касающимися управления стейкхолдерами в малых проектах. Основная задача исследования и его результат - расширение существующего процесса управления стейкхолдерами и создание модели, включающей основные принципы теории игр. Для достижения поставленной цели была проанализирована релевантная литература, проведены глубинные интервью с проектными менеджерами и сформированы три бизнес-кейса, описывающих применение элементов теории игр в малых проектах. Основной методологией исследования послужила этнография, а основным результатом - сформированный алгоритм настройки заинтересованных сторон под цели и результаты проекта.

**Ключевые слова:** управление проектами, малые проекты, теория игр, взаимодействие со стейкхолдерами, модели коммуникации.

**Abstract**

The principles of Game Theory and the games that emerge as a result are academically intriguing and can help us consider various strategies for interacting with the people around, especially those in the professional settings. Effective communication has always been a key to building a successful project management process. This research serves as an attempt to close the gap between game-theoretic way of thinking and existing project management models. In more detail, my research aims at creating a consistent framework for a stakeholder analysis, implementing some tactics, tools and techniques from mathematical analysis of cooperation and conflict. The research goal is going to be achieved by implementing the bounded ethnography method based on inductive approach. The results of the study elaborate on the possible applicability and significance of Game Theory in the project environment and provide project managers with a powerful extension of traditional stakeholder analysis. Generated Stakeholder Calibration Framework (SCF) is the final research outcome.

**Keywords:** game theory, project management, communication, stakeholders, small-scaled projects, framework, Lancaster University.

**CHAPTER 1. INTRODUCTION****1.1. Study background**

Today's global economy can be characterized as being chaotic and competitive at the same time [32]. Modern successful organizations are constantly ready to fight for profit, human resources, market position and other temporary advantages to gain long-term benefits [4]. For example, Jack Welch suggests that business is all about winning [52]. However current business environment generates even more obstacles to achieve such goal. Increasing information uncertainty, continuous globalization and demanding technological progress requires

the company to have instant reaction, smooth communication process and creative approach for making a decision. Project management discipline possess the range of various theoretical models, methods, tools and best practices to overcome these business hurdles and generate competitive advantage [46].

The next step to accomplish previously mentioned organizational goal seems straightforward and logical. Company should break down the concept of project management to define where is the line between successful and failed projects [39]. They are many research papers written on the topic of analysing project success outlining different criteria, factors and performance

correlation [21]. Nevertheless, the majority of authors agree that stakeholder satisfaction is the critical part of any prosperous investment alternative. This element generally involves dealing with people: negotiating with various interested parties and providing a solution that will keep the project moving forward [17].

A typical procedure of interaction with stakeholders during the majority of projects usually starts from realizing a simple idea — each interested party requests the unique set of benefits based mostly on their personal goals [14]. In a worst case scenario, a key stakeholder can miss personal objective, begin worrying and finally influence project results to compensate his expected loss [49]. Therefore, project manager should pay extreme attention on planning their own strategy in response to prevent the stakeholder's possible detrimental actions or to maximize the project benefits. In other words, project manager has to simulate potential conflict or perspective cooperation by building a consistent communication process.

This idea is also true for project teams, which are usually cross-functional, gathered from people who never worked before and also have personal goals. Such environment can become a source of future disagreements on task allocation, communication flow and preferred work pace [10]. As a result, certain team members may decrease their efforts, ignore project meetings or constantly conflict with others. Thus project manager's responsibility is to turn independent workgroup into a motivated high-performing organism [18].

Both situations mentioned above have a number of common traits: strategic context, lots of persons acting within individual interests, basic assumptions and possible impacts of their behavior on project performance. Game Theory as a separate branch of mathematics uses the similar structure to observe, understand and find an optimal solution to the cases based on decision-maker's interaction [35]. The survey of mathematical models of cooperation and conflict among rational decision makers was firstly conducted more than 60 years ago to solve prisoner's dilemma [33]. Many famous scientists including John Nash and Oskar Morgenstern [31] advanced the concept of Game Theory by introducing a set of criteria for understanding and predicting players' strategies under various circumstances. Since then Game Theory approach has been thoroughly applied to study human behavior in different spheres such as business, political science, biology, logic, psychology, computer science, philosophy and poker [26]. The reason for such diverse popularity can be clearly described as universal-

ity. To be more specific, the games studied in each area of knowledge usually have similar structure, main goal (seeking a certain form of equilibrium) and provide researcher with valuable insights towards human behavior under explicit circumstances that can later be used for strategy forecasting [35].

Despite approval of Game Theory concepts among various areas of knowledge and its potential to address complex strategic problems, there is a small number of publications related to its implication in the field of Project Management. Recent associated articles mainly focus on applying a particular model from Game Theory to a very specific aspect of project planning or execution in a particular industry. The examples include designing contract agreements [23], constructing a consistent project schedule [1] or cost allocation under condition of uncertainty [13]. Although mentioned papers possess some useful and inspiring thoughts, the results of such studies can't be extrapolated to more general ideas. Thus there is a necessity to classify and systematize the existing scientific experience in the sphere of game theory application in project management.

Another important reason to conduct this study is that a typical project is rich with uncertainty related to the unique result and involves dealing with high level of complexity described by quantity & interactions between various management factors [37]. Game Theory approach is able to guide a project manager through uncertainty by predicting most possible outcomes and support him in choosing best case scenario under certain circumstances [45]. To specify, most of well-known interactions presented in Game Theory such as prisoner's dilemma, chicken game or stag hunt can be extended to suit communicational conflicts, stakeholder management or risk analysis.

The overall purpose of this research is to identify and analyze potential benefits of Game Theory aspects which may be applied to deal with different project management issues. The special attention will be paid to linking Game Theory with managing various stakeholder requirements in small-scaled projects where cooperation and conflict situations play a vital role in delivering planned products or services. The investigation is aimed to fill the gap between practical application of Game Theory techniques and project management theoretical concepts.

### *1.2. The professional significance of the study*

The study explores how project managers perceive interaction with key stakeholders and advices what can

be done to maximize benefits from it. The investigation will be of primary value for project managers, as well as functional managers and scientists struggling with uncertainty in constructing reliable game theory models in different disciplines. Project and functional managers may similarly apply the results of this research to solve the frequent resource allocation problem that occurs in matrix organization structure [44]. Professional researchers can also benefit from the bounded ethnography method implemented to shape the final framework. Another possible benefit of this study touches upon the various insights generated during the qualitative research that can be extrapolated to similar project situations.

### 1.3. Research scope and questions

To sharpen the research focus on understanding how certain Game Theory concepts may be utilized in the field of project management we have to answer the following questions:

#### 1. Why game theory is one of the valid tools to successfully manage communicational risks, solve conflicts or help to build active stakeholder engagement in a small-scaled projects?

First research question will mainly be focused on providing general information towards Game Theory applicability in project management. Achieving this goal might be connected with certain difficulties. To be more specific, game theory utilization can provide a field for various manipulations in projects. For instance, applying such tool as payoff matrix to explain, evaluate and predict stakeholder behavior can lead to oversimplification that will mean not taking into account certain variables and result into incomplete analysis. Furthermore, a simple well-grounded intention to obtain more information before choosing an optimal strategy may cause some ethical issues. By this I mean that data confidentiality could be one of the project requirements and create an obstacle before finding an optimal solution. In addition, project risks tend to evolve and cause correlated risks which change initial assumptions and affect the equilibrium. Therefore, it is essential to choose adequate research methods, determine correct sample size and select appropriate participants.

Despite the fact that the first research question is closed ended, finding answers procedure should be aimed at getting more detailed data for various aspects of project management. Achieving this goal will prepare the set of interrelated variables for further analysis.

#### 2. How Game Theory aspects are implemented in small-scaled projects and what general assumptions should

#### be made prior to applying mathematical analysis of cooperation and conflict in project management?

In this section of study, I will mostly concentrate on some specific situations that usually happen during project completion and have a relation to Game Theory. Main goal of the second research question is to generate an answer towards how exactly can specific ideas from Game Theory support the achieving of project goals, improve manager's soft skills in terms of developing mutually beneficial relationships with stakeholders and advance planning process? The objectives are going to consist of providing a clear description of relevant situations, conducting a thorough analysis and identifying their impact on project outcomes. The results from this part of the research will also solve application problems stated in the previous research question.

#### 3. What are the recommendations for further application of Game Theory concepts in small-scaled projects?

According to the results of the second research question we already produced the list of game theory models and theoretical aspects that have an impact in project management environment. The next goal is to define the most efficient way to apply this aspect in project management general areas of knowledge. Thus the objective for this research part should be to build a consistent framework of Game Theory application using the data from first and second research questions.

Answering research questions stated above will allow us to get a general overview of various Game Theory models, analyze possible benefits from their integration in project management and especially stakeholder area of knowledge, provide the necessary guidelines for application and structure generated ideas for further practical use.

The structure of the following research is going to support achieving the initial research goal. The study will utilize the works of many classical and famous Game Theory scientists including Ariel Rubinstein [35], Oskar Morgenstern [31], Roger Bruce Myerson [33] as well as surveys from various project management researchers and experts such as Harvey Maylor [30], Dennis Lock [24] and Rodney Turner [47]. In addition, the research is going to extract necessary information from Project Management Body of Knowledge (PMBok) standard [38], the second version of Projects in Controlled Environments (PRINCE2) methodology [27] and a specific review paper on how to use PRINCE2 in small-scaled projects approved by PRINCE2 authors [11]. Furthermore, multiple reports from different project management conferences will be addressed and examined to create the consistent framework.

## CHAPTER 2. LITERATURE REVIEW

### 2.1. Basic sources

In my research I will use Project Management Body of Knowledge (PMBok) definition of a project and project management [38]:

*“A **project** is a temporary endeavour, undertaken to create unique product, service or result”.*

*“A **project management** is the application of knowledge, skills, tools and techniques applied to project activities to meet the project requirements”.*

There are several reasons to choose PMBoK as a theoretic fundament for the further study. Firstly, stated above definitions outline project uncertainty in fast paced business environment by taking into the account such characteristics as uniqueness and transiency. Project managers frequently try their best to reduce or avoid the uncertainty [37]. Game Theory possess all necessary elements to structure, evaluate and offer clear guidelines in complex or ambiguous situations [41]. Secondly, provided concepts refer to understanding project as a mean to introduce change in a company. Mathematical analysis of cooperation and conflict under rational decision makers was also firstly introduced to implement strategic changes and predicting companies' behavior in business environment [9]. Thirdly, PMBoK standard pays a lot of attention to cooperation aspect (for example, utilizing organizational breakdown structure for a specific project team or organizing the communication flow process) among stakeholders with logical reasoning (for example, task allocation process which is often based on competences, knowledge and skills) which are crucial parts for assembling Game Theory models.

Apart from fundamental project definition, the research is going to take into account the traditional way of evaluating various stakeholders illustrated in PMBoK as well. I will mainly focus on the identification procedure that usually involves implementing a thorough analysis of people affected by or interested in the project This should be followed by demonstrating the links between existing stakeholder analysis and Game Theory principles.

The small-scaled projects are usually characterized by such factors as [11]:

- short term duration;
- simple and well defined project scope with stable dependencies between activities;
- low person working hours;
- fit for purpose in terms of quality;
- small project team size;
- low risk with possible modest changes;

- clearly defined benefits extracted directly from deliverables.

The Game Theory topic will be introduced by the books of Antony Kelly: “Decision Making using Game Theory” [20] and Ariel Rubinstein: “A Course in Game Theory” [35]. One of the main reasons to choose two stated authors is that they both take into account the concept of bounded rationality and provide many examples which can be extended to project management cases. The majority of definitions and guidelines will be transferred from these sources. The further research will use fundamental game theory concepts such as Nash equilibrium, dominant strategies, sequential equilibrium, credible threat & trust, signal tactic & focal points. The special attention is going to be paid to so-called classical games involving both cooperative & competitive types with perfect or imperfect information. By this I mean prisoner's dilemma, chicken game, cutting cake situation and ultimatum game.

According to Ariel Rubinstein [35] Game Theory is a set of analytical tools designed for studying strategic, rational decision making processes of individuals who interact in a specific environment. This discipline was initially developed to predict situations where one of the players performs better at another expense.

The models or the games are abstract representations of real situations and have the following structure:

- formal system built on specific rules;
- the players that interact with each other;
- variable and clear outcomes or pay-offs as a result of interaction;
- outcomes possesses a different value;
- the players are emotionally involved and have an impact on the outcomes through their actions;
- outcomes depend on the behavior of each player.

From the game theoretic norms revealed above it can be clearly seen that small scaled projects are much easier for representation of the real situations. In more detail, I mean that medium or large scaled projects usually involve more interaction between key players and can even produce the set of interrelated games because of longer duration, complex scope and lots of projects changes. Therefore, Game-Theory modeling process for the small scaled projects can be done in the brightest way to outline every significant detail and focus on the possible implications.

### 2.2. General application of Game Theory in project management

Project management is a very demanding role because it combines characteristics from authority, responsibil-



ity and accountability at the same time [32]. Furthermore, usual activities for a typical project manager mostly involve negotiating with stakeholders to keep the execution process smooth and to meet initial expectations. Game theory is able to teach managers what will be the right time to apply their huge mix of soft & hard skills and how to control stakeholder's requirements better. There are also a number of studies related to game theory applicability in terms of stakeholder engagement and communicational issues. Some authors conclude that the implication of game theory allows understanding the requirements and interests of involved persons to close the project more successfully [7] while others state that in most cases game theory oversimplifies the relationships between project team and key stakeholders [54]. However project practitioners agree that applying game theory approach to every stakeholder should transform your vision and make notice more details that may become later valuable on the next stages [45]. Moreover, it is crucial to identify the type of game project manager is playing with an interested party because this helps to generate adequate response strategy. For instance, in a zero-sum game where a player claims benefits at the equal losses of others the mixed strategy is going to produce maximum result. Taking this idea into consideration project manager may predict the behavior of conflicting stakeholders. Thus he can develop a more consistent and reliable mapping process of interested parties. Another valuable experience of implementing Game Theory can be found in the paper written by Aleksandra Odrowska [34]. Author compares project team's interaction to the behavior of online gamers who create guilds for receiving more benefits. Article explores how theory related to individual communications in well-defined contexts (similar to games) can describe and explain collective behaviour. Author provides support for this theoretical method with an examination of data collected as part of an ethnographic research, through several focus groups, and a survey sent to 333 World of Warcraft players. Paper concludes with a discussion towards the similarities between online guilds and project teams. Research also provides a list of guidelines for predicting collective outcomes in certain types of online games.

Approach that is more precise was taken by Azin Shakiba Barough, Mojtaba Valinejad Shoubi and Mohammad Javad Emami Skardi [2]. Authors concerted on conflicts between various parties involved in construction projects. They demonstrated the need for better decision making method which aims at the best outcome

for each player taking into consideration opponent's decision. Prisoner's dilemma and Chicken game were used to create probabilistic conflicts and generate a possible Nash equilibrium. This article is quite useful in terms of analyzing the possible game theory integration into classical construction projects. In addition, it shows how important is cooperation to achieve best outcome. The paper written by Merce Mach and Yehuda Baruch [25] extends the topic of conflict and cooperation to the field of project teams. Authors aim to examine how collective orientation, faultiness and level of trust affect team performance in cross cultural context. The research found out that trust operates as a facilitator for work attitude, various perceptions and the outcome. Nevertheless, some of the studied team members consider trustworthiness to be dangerous in the beginning of the project where everyone is trying to achieve personal goals. The relationship between this important concept and performance tends to be not linear and complex [55]. Article also outlines that cooperative atmosphere does not decrease the probability of potential conflicts but still has a positive impact on project results.

Describing existing papers related to the specific aspects of project management, it is essential to demonstrate that many scientists examine traditional coalition games connected with delay cost problems to decide the fair share for each player who affected project delay to come up with more accurate schedule [16; 13]. Mentioned papers analyse situations in which a project consisting of several activities is not executed according to plan. Main attention is focused on how to divide the total reward (penalty) among the allocated activities: the core of a corresponding cooperative project game determines a list of stable distributions of the final reward. Authors present scheduling problems as abstract experiments where coalition game principles may later be applied.

More useful bits of game theory implication can be extracted from typical information distribution problems which usually take place while implementing mathematical models of cooperation and conflict. Three articles here present a particular interest. First paper written by Rouven Bergmann [5] concentrates on dealing with moral hazard in innovative projects. Author describes a situation where a risk-averse research and development managers are introduced to an incentive contract. Article concludes that incentives built on the organization market value have to be stronger in an environment with weak information asymmetry. Thus in smaller companies risk-averse project managers should be paid compensa-

tion based more on project financial performance than on efficiency objectives. Another important point is that short-term economic motivation tends to decrease the probability of morale hazard in highly dynamic markets. Second article touched upon a similar idea is Zhanna Belyaeva and Alexander Kazakov's research [3] on building a CSR model of stakeholder interaction in Russia and China. Authors point out usual issues affecting the Nash equilibrium in most games such as adverse selecting and information asymmetry. Article demonstrates how these problems will change pure strategies and what should be done by government institutions to move to win-win situation. In terms of project control it shows the importance of top management in organization and possible scenario caused by game theory issues. Third research conducted by Robin Mason and Juuso Valimäki [29] aims at analysing the efforts of principal (organization) and agent (project manager) under contract agreements with and without commitment. The investigation is built on assumption that there is a constant information asymmetry between project manager and a company initiating a project. Both parties have special tactics to influence the project results: agent is able to decrease his efforts while principal can provide more incentives. Due to Parkinson's Law [36] project manager tends to reduce his current effort substituting towards future attempts before project completion. Organization notices that and similarly lowers the payment. To resolve this issue, authors propose a continuous time model that focuses on the project results and the level of commitment of principal and agent. In other words, the research is trying to solve the classic Game Theory problem when players utilize information asymmetry to their advantage by implementing dominant strategies. This usually leads to non-optimal equilibrium that will be mutually detrimental if the game repeats. To prevent this dynamic incentives structure was developed. Described papers clearly shows how the balance between payoffs can be restored and kept.

Despite that Game Theory is able to reduce project uncertainty by deconstructing it to abstract elements and providing clear instructions on what strategy to implement in the complex situation [41] there is still an assumption of complete rationality for the decision-makers [35]. As it was said before project environment is rich with information asymmetry and limited with time to choose a right strategy. Therefore, Game Theory has a concept of bounded rationality where decision makers are looking for at least satisfactory choice rather than the most optimal one [20]. Project stakeholders

mainly choose different strategies taking into account corresponded risks and potential involved benefits [32]. However, they do not possess the complete information, have personal preferences and lack the necessary amount of time to select the best case scenario. Thus there is more and more studies linked to implementing evolutionary Game Theory with bounded rationality and possible stakeholder behaviour [50]. Such researches are aimed at constructing a benefit maximisation function including risks and allocated resources from the point of incomplete rationality. Authors also assume that implementing such benefit maximization model can make stakeholders and project manager act more rational.

### *2.3. Game Theory concepts & stakeholder management*

As it was mentioned before, in the field of project management Game Theory still remains at the starting point of its practical application. However, several studies outline the importance of game theoretical patterns at different types and sizes of projects. One of the examples is the article written about implementing cooperative guidelines as a creative method for managing communication risks by Katerina Bockova, Gabriella Slavikova and Juraj Gabrhel [8]. Article considers Game Theory as a tool to establish and plan the project to be the game that gives an opportunity to maximize gains and minimize losses. According to the authors opinion decision process based on Game Theory concepts is not only about personal knowledge and strategies but more significantly about those of others in the project to achieve success. Therefore, applying such instrument to every project stakeholder should help to see things in a new way. The paper has a particular interest for the examination because authors try to find evidences to Bilton and Cumming's hypothesis [6] — “the use of Game Theory makes it possible to understand the needs and interests of the involved persons in a better way and to finalize the project successfully”. As a result, from a literature review and structured interviews with project managers in Czech Republic article proposes a list of steps towards how to utilize Game Theory on a daily basis to evaluate the others person strategy and improve negotiation process to keep project on track. Unfortunately, research outcomes are very general and mostly include questions which should be considered prior to any important project communication including:

- What does the person involved in the communication gain or lose? Is there a time limit to make decision?

- Would it be in our best interest to share details prior to the negotiation if the game is cooperative?
- Is it to the mutual advantage to determine the nature of negotiating process? Should it be simultaneous or sequential?
- What are the mutual and achievable objectives for cooperative, and non-cooperative games, what are the aims of the stakeholder project manager is negotiating with?
- Is the person able to commit on the behalf of only himself or others involved?
- What are the potential risk areas of chosen strategy or selected communicational approach? How can stakeholders use unique information about project to get the advantage?

Moreover, author do not specify what should be done with received information and how it can be integrated later in the stakeholder analysis. Despite mentioned downsides the research is able to supplement and advance the existing stakeholder analysis procedure that is implemented by the majority of project managers.

According to the PMBoK [38], stakeholder management process for any project includes four main stages (Fig. 1) — identification, planning, managing engagement and controlling.

The identification stage and the process of stakeholder analysis, in particular, presents the most interest for the further discussion. During the first stage the project manager usually recognizes people, groups and organizations that could impact or be affected by an activity, decision or specific project results. This is frequently followed by gathering and scrutinizing relevant information regarding stakeholder’s interests, influence, interdependencies and possible impact on project success. Conducting such stakeholder examination has a goal to prepare a solid fundament for further prioritizing and planning engagement actions.

If we take a closer look on the process of stakeholder analysis, mentioned in the PMBoK, we may notice lots of similarities with the core elements of Game Theory [35]:

- formal system built on specific rules — **assessment of various stakeholders based on expert judgment and decision-making principles**;
- the players that interact with each other — **interdependencies between key stakeholders**;
- variable and clear outcomes or pay-offs as a result of interaction — **multiple classification models including power/interest, influence/impact and power/influence grid**;

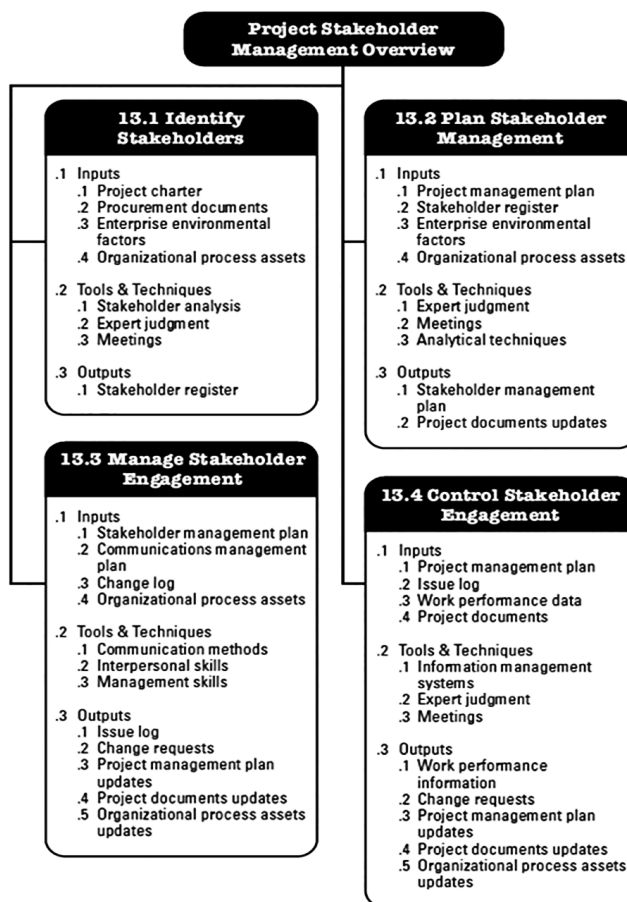


Fig. 1. Project Stakeholder Management Overview (PMBOK)

- the players are emotionally involved and have an impact on the outcomes through their actions — **attempt to prioritize stakeholders that relates to their involvement in the project.**

Apart from described elements, the main bridging principle is the way how PMBoK [38] assesses key stakeholders at the end of the analysis process. According to the chosen standard, a substantial amount of attention should be paid to possible reactions of interested parties under different circumstances in order to «enhance support and mitigate potential negative impacts». This is a very good illustration of Game Theory historic objective to predict the behavior of the other player [20]. Regarding the stage of stakeholder identification, PMBoK clearly tries to construct a game between project manager and interested parties. Nevertheless, there will still be a methodological issue — Project Management Body of Knowledge deals with stakeholders as «objects» when they are more like «subjects» [48] In fact, many project management methodologies and standards take into account only frivolous interests of involved stakeholders,

caring less about potential values and benefits that might be achieved through specific interaction.

## CHAPTER 3. METHODOLOGY

### 3.1. Research approach

Research methodology is a comprehensive strategy which choice should be based upon the type and features of the research problem [53]. In this section I am going to outline the overall logic of further study, define appropriate methods, link them with stated research questions and proceed with investigation objectives.

My research aims at studying of possible game theory application in the field of project management in terms of solving communicational conflicts and improving stakeholder engagement related to small project teams. To specify, the goal of the research is to construct a consistent framework on how to maximise benefits from implementing Game Theory in small-scaled projects. In other words, the research deliverable will be a general model or a new piece of theory that is based on in-depth study of particular events. According to Louis Cohen [12] ethnographic approach to the research is suitable for analyzing perception based data and is able to generate original theoretical concepts. Ethnographic approach seems also a decent option if not large sample of data is available to the researcher. Ethnographers perceive human behavior as socially situated and unique which connects with the variety of games played by people executing the project.

More reasons to pick this type of research approach can be found in the book by Harvey Maylor and Kate Blackmon [30]. Authors state that before conducting a study you have to carefully examine previously identified investigation questions. Research questions for this research (Chapter 1, Section 3) are mainly focused on identifying the meaning of the problem and not the measurement. It can be noticed that all of them begin with **how**, **what** and **why** while typical scientific approach utilizes words like **how much**. Moreover, developing a new piece of theory corresponds with subjective nature of the study that contradicts the scientific method [22]. Another thing worth mentioning is that implementing the inductive approach when a researcher starts from a specific situation and continues working towards universal principle. In other words, such approach makes it much easier to construct a framework [30]. Taking all mentioned reasons into account I have decided to choose **bounded ethnography** approach that combines a reasonable level of depth with a flexibility in terms of time-

limited projects. Topic of this study implies deeper understanding of game theory elements buried beneath project management rules and guidelines. To specify, on the first stage we have to look for common patterns and then recognize general principles of game theory in project management. This may look similar to scientific approach that concentrates on finding similarities and involves careful and accurate data analysis [30]. However, this information will not be enough to construct a consistent framework for various reasons. Firstly, literature review can produce only general ideas that should be shaped and narrowed to the specific area of knowledge. Secondly, such insights are not able to advance the research topic further. Therefore, the study will implement more investigation tools.

Ethnography usually implements qualitative methods as they are considered to have required level of depth to understand the meaning of one particular situation or event [12]. Qualitative data is also easier for categorization, having in mind the picture of the final framework. Therefore, the research should start from a literature review. Then it has to be followed by a specific situation that will be later broken down tested and evaluated from a point of common patterns identified earlier from a literature review. This can be done by in-depth interviews and content – analysis of the project documentation. Further synthesis should outline the efficiency of game theory application and identify the possible way to develop a framework.

### 3.2. Methodology design

To fulfill the purpose of the research, succeed in implementing research approach and answer research questions stated above following research design is going to be implemented (Fig. 2). The main purpose of the following structure is to demonstrate how ethnographic approach can result into creating a new part of theory. In more detail, the process is going to start from deduction, combining valuable insights from literature review, and continue with induction, working through singular insights towards general principles produced from Content-Analysis and In-Depth Interviews. Final framework is going to be the final research outcome.

This structure can be outlined in the four main stages below:

1. **Data preparation.** This stage involves doing critical analysis of literature towards Game Theory concepts in various areas of project management. The results will help to reveal two things. Firstly, our research will generate reasons for implementing game theory



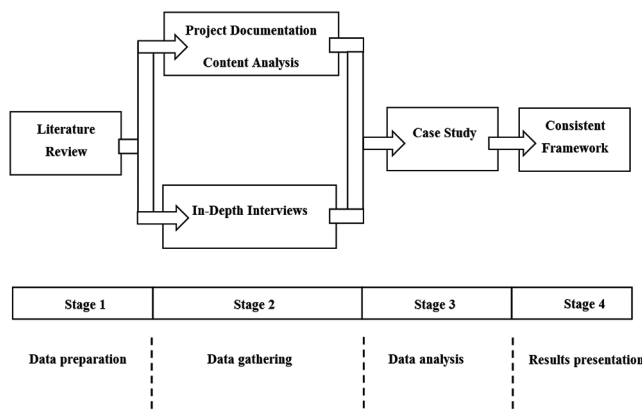


Fig. 2. Methodology design

concepts in the field of project management. Secondly, the common patterns of game theory application in the vast body of literature are going to be presented.

2. **Data gathering.** On the second stage it is necessary collect a substantial amount of information for further examination. This involves conducting in-depth semi structured interviews with project managers operating in small-scaled projects towards their use of game theory elements and analysis of project documentation. Interviews are going to testify the necessity of game theory concepts in small-scaled project oriented environment. Project documentation content analysis will generate a certain number of situations where Game Theory could have been used and what might be the possible effect on the project outcomes.
3. **Data analysis.** Third stage has an aim to prepare a fundament for a later developed framework. Cases based on three small-scaled projects are going to outline the common principles revealed after literature review, demonstrate the insights generated by interviews and provide further implications for a similar situation.
4. **Results presentation.** Fourth stage is focused on synthesis of above mentioned results into a consistent framework that can be used later in the small-scaled projects. This should be done by integrating outcomes from thorough literature review, semi-structured interviews and content analysis from actual projects.

### 3.3. Methodology issues

After presenting the general research design it is necessary to provide more details towards particular methods which will be used later.

**In-Depth interviews** are defined as a qualitative research technique that frequently involves carrying out

intensive individual interrogations with a small number of participants to explore their opinion on a particular topic or situation [56]. Since the research goal is to construct a consistent framework that requires detailed information towards project managers' behavior under different circumstances, In-Depth interviews seem as the most natural approach to achieve this goal. In addition, interviewees are going to provide a more complete picture of what problems happen during executing small-scaled projects and why.

**Respondents.** Interviews usually start from sampling. "Appropriate sample size for a qualitative study is one that adequately answers the research question" [28]. The sample will consist of 9 students from Lancaster MSc Project Management and 3 employees from Q2Q Ltd IT company located in the same town. Interviewees were selected mainly because respondents are usually busy executing the small-scaled projects in multiple industries. To be more specific, MSc Project Management in Lancaster University suggests executing 3 small-scaled projects and completing PRINCE2 Foundation certification at minimum. At the same time, Q2Q Ltd usually delivers projects for small and medium sized enterprises (SMEs) where communicational aspect, short-term duration, fir for purpose and clearly defined benefits are the core aspects.

The questions were chosen according to the results of literature review. Each question represents the certain section in Game Theory application and is designed to generate more specific response. The whole interview consisted of six questions outlining topics identified on the data preparation stage.

Data validity for the interviews in this research is based on:

- personal acquaintance with interviewees. By this I mean the high level of mental comfort and constructive context of answers;
- professional acquaintance with project management procedures, working conditions of the organization;
- interviewee wish to implement some the results of the research in enhancing current procedure of stakeholder analysis.

All interviews were recorded, transcribed and analyzed to fit the purpose of the research.

**Qualitative Content analysis** suggests implementing a bundle of techniques for systematic text examination [30]. While literature review provided necessary research frames and In-Depth interviews guaranteed the appropriate content, Project documentation content analysis

is going to set the essential environment to produce a final framework.

Documentation for the analysis will be based on term 1, term 2 and term 3 projects where I worked during completing MSc in Lancaster. The main reason is that all three projects were small-scaled and I had full access to observe and examine the documentation referred to planning and execution project phases. On the third stage specific situations will be extracted and carefully analyzed. To maintain this approach 3 case studies are going to be created. Each case study will be precisely structured to reflect the real situation from term 1, term 2 and term 3 small-scaled projects completed in Lancaster.

It is also worth mentioning that methodology described above requires the compliance of the research ethics norms. I can confirm that in this study I will observe and maintain ethical standards set by Lancaster University and National Research University Higher School of Economics. Full confidentiality of the participants will be guaranteed and all the primary data and research documents are going to be secured for a proper period of time.

## CHAPTER 4. ANALYSIS, FINDINGS AND INTERPRETATIONS

### 4.1. Literature review summary

According to proposed earlier methodological design, before carrying out semi-structured interviews it is necessary to prepare data. Firstly, this stage helps to organise a consistent fundament for developing further interview questions. Secondly it provides a necessary direction towards creating a final integration framework. In this section of the research I will summarise common patterns of the majority of literature sources relevant to Game Theory application in the field of project management.

To address the first research question we have to outline the topic of **Game Theory definition** in the eyes of project managers. Through the qualitative studies conducted by Katerina Bockova [7], Gabriella Slavikova [8], San Cristobal [43] and books written by Chris Bilton [6] & Michael Hatfield [25] it is obvious that project managers implement various concepts from Game Theory but call it differently. It is also worth mentioning that stakeholder analysis described in PM-BoK [38] takes many core elements of Game Theory and attempts to simulate it through picking right engagement strategies in response. Therefore, gathering all shared opinions to produce a universal meaning for

mathematical analysis of conflict and cooperation seems as a reasonable idea.

Another vast number of literature sources touch upon the topic of **Game Theory applicability for specific purposes of project management** [1; 54]. By this I mean that authors focus on detailed implementation of single aspect from Game Theory for a certain project management problem. Articles involve scheduling issues, stakeholder engagement, risk analysis and relationships within a project team. The further interviews are going to support or refute an argument of game theory applicability in the specific project management areas of knowledge.

Ways to manage **team commitment through trust or threats and resolve possible conflicts** are also common themes for scientific investigations. Many authors [55; 2; 25] focus on studying how generated trust in cross functional and cross national team affects the performance. Researches demonstrate that trust is not always perceived equally good by all project team members but is very efficient in terms of overcoming personal disagreements. It will be valuable in terms of answering the second research question to examine project manager's perception of a threat & trust concepts and its possible application when facing a disagreement.

**Moral hazard and information asymmetry** was one more topic which is widely spread in the current literature corresponding with game theory application in project management [5; 3; 29]. The common point of these studies is that key stakeholders or project manager itself usually has more knowledge, skills and information to take actions in their advantage. As the result both players tend to end up not with an optimal equilibrium. According to the articles in this section the equilibrium should be forced by dynamic incentives or government intuitions. Small-scaled projects extremely depend on communication with stakeholders. Another interesting idea from these sources is to receive stakeholder feedback about his own actions to assess possible threat. Thus, project managers will be able to present a vast number of ideas of how to deal with moral hazard [11].

**Bounded rationality** concept tends to be one of the promising areas for further integration of project management models with game theoretic way of thinking. Taking into account the results from related articles [50] and the context of the second & third research question it should be beneficial to examine the perception of rationality in small-scaled projects. The questions may reveal the approach and relationship to this Game Theory assumption in a small-scaled project.

#### 4.2. Semi-structured interviews outcomes

All the interviews were recorded and after that transcribed for the goal of data analysis. Research ethics was carefully checked formulating interview consent and taking interviewee's permission for processing of required information, anonymity, confidentiality and personal safety [30]. Research scope was chosen according to initial methodology design to fulfil research goals.

The discussions of Game Theory integration with different areas of project management were structured in relation to literature review summary (Chapter 4, Section 1) and consisted of six different topics. Each section had a specific list of questions outlining different parts of the topic. The main outcomes are summarized below (Fig. 3):

##### *Game Theory definition*

1. The majority of project managers already know several elements of Game Theory from studying in University, mass-media or related disciplines (economics, politics, biology) and have experienced different implications of it in everyday life.
2. Q2Q employees heard of Game Theory and can draw analogies related to chess and poker.
3. All of the participants consider game theoretical elements as useful tools to predict human behaviour.

##### *Game Theory integration with project management*

1. MSc project management students agree that Game Theory can be integrated with such PM areas as stakeholder management, risk analysis or project team interaction.

Risk analysis. "I think we can decrease uncertainty and at the same time improve contingency & mitigation planning process by simulation of various stakeholder actions.

Project team dynamics. "In my opinion, project manager is able to predict the behavior of independent project workers or provide necessary incentives for workgroup and shape it into cohesive a whole".

Stakeholder management. "Well, I guess communication process may be based on possible stakeholder's response. **To my mind, project managers are already using some elements of game theory when they are trying to define the communication strategy**".

2. Both Q2Q employees and young project managers think that you have to spend lots of time adapting mathematical models of cooperation and conflict to practical use.

"However to my mind project manager should take lots of variables into account and be emotionally bulletproof".

##### *The concept of trust and threat*

1. Lack of trust usually affects the process of completing project activities and may have a humble effect on a project results.

"For example, in Term 1 project I have assigned certain activities only to persons I met before in campus and considered reliable."

2. Project Manager should be the person responsible for moving other team members to optimal state by using threats, signals or other tactics to change payoffs in the game matrix

"Project manager should always pay attention to such little things and implement various negotiating tactics otherwise it can trigger serious consequences".

"Threat can be a good short-term motivation but should be flexibly used with other tactics"

3. Trust has an impact on the leadership strategy in a project team.

"During my BSc project we did not have a clear hierarchy. Several team members were overconfident and decided to do a substantial amount of work. But they didn't take it seriously, were late and started seeking for help".

4. Prisoners dilemma and chicken games happen a lot in the beginning of the project.

"As I remember from Term 2 project there was a situation related to the prisoner's dilemma. One of the team members started to work more while the others began to slack off".

5. Frequent team building events are very useful in terms of generating trust.

"The answer is once again setting more team building events to build more trust or create an image of a super professional who will be perceived as the most powerful".

##### *Conflict resolution*

1. Dominant strategies are not so effective while building long term relationships, organizing communication plan or facing a disagreement

"Dominant strategies are clearly what to avoid during the disagreement because it makes team more independent".

2. Facing the conflict or disagreement lots of team members usually pick the strategy which is safest in terms of generating personal stress but the worst choice for project results.

"During a conflict most of the team members decided to keep silent and ignore the disagreement till it goes away. This was a response to my pushy behaviour. Now I understand that this was the safest option".

3. Trust makes not afraid of project conflicts and increase chances of successful cooperation.
4. When solving a conflict situation project manager should pay attention to different incentives of players.
5. Project manager tends to utilize dominant strategies more than cooperative ones.  
“Project manager has an additional motivation to end disagreement in a fastest way possible, because he will be blamed for the failed results”.
6. Optimal Equilibrium is far more achievable when the whole team cares and understands its rationality.

*The effect of moral hazard and information asymmetry*

1. Moral hazard and information asymmetry situations were faced by the majority of project managers during small-scaled projects.
2. Stakeholders may cause moral hazard by trying to implement various dominant strategies.
3. Moral hazard within team can be avoided by threats, shared responsibility approach implementing autocratic leadership in the regular communications including team meetings and frequent project updates.
4. Moral hazard caused by external stakeholders should be overcome by making a special contract agreement which includes substitution options, feasible objectives, accurate quality criteria and possible punishments & rewards.
5. Ground rules is extremely important project document in terms of preventing information asymmetry.

*Rationality of decision making*

1. Demonstrating just pay-off matrix can help to persuade some team members to change their decisions.
2. Game Theory models when presented give a basis to express arguments if they are based on another leadership style and convince more emotional people to follow your strategy.
3. Game Theory concepts may encourage rational people and distract emotional persons at the same time.
4. Game Theory is able to change project manager's personality and make him consider things more rationally. Make more smart and reliable decisions under conditions of uncertainty. Assign tasks taking into the account not only abilities but also character traits and preferences.

Fig. 3. Semi-structured interviews results

These insights evidently answer the first research question towards Game Theory applicability in different areas of project management. To be more specific re-

spondents perceive mathematical analysis of conflict and cooperation as one of the valid instruments to build a successful communication strategy, solve internal project conflicts, engage stakeholders and proactively deal with information asymmetry. Moreover, Game Theory tools can affect project manager's personality by taking more rational decisions.

*4.3. Project documentation content analysis*

This section of the findings is devoted to constructing and scrutinising cases connected with Term 1, Term 2 and Term 3 small scaled projects. The following situations are deconstructed in below (Fig. 2, Fig. 3, Fig. 4). Each table contains case description, analysis from game theoretic perspective and further implications. Games were mostly solved using iterated elimination of dominant strategies approach [35].

**Case 1**

**Situation description.** This was my first project in Lancaster with a group of completely random and independent people from different cultures. The project objective was to select any world record from Guinness Record Book and shoot a promotional clip that demonstrates the attempt to break it. Taking into consideration that our team members did not possess any unique talents we have decided to organize an event in Sports Centre for anyone fancy to set a new record. We soon received initial agreement. In this moment the project attracted a new powerful stakeholder who could affect the final deliverable. Our team faced a dilemma on how to approach Sports Centre.

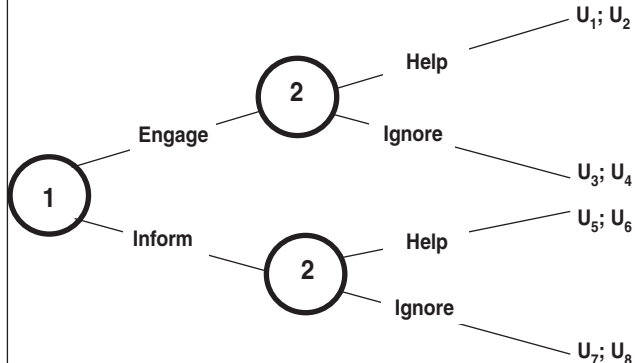
*Should we try to engage them as soon and deep as possible or formal arrangement and several contacts will be enough for a successful event?*

Everyone agreed on the second option. On the scheduled in the middle of the event a strange group of people appeared near the doors. When we asked them what was going on, one person replied that their group has reserved this room yesterday for 2 hours and the time should start now. Our project manager demonstrated them a letter from Sports Centre and then took them to reception to discuss the issue. The problem was that the manager responsible for room booking was ill and forgot to update the schedule. Nevertheless, we have communicated a lot with other managers before the event and they remembered each person from our team. Thus the problem was smoothly solved. That group of people had been redirected to a free room.



**Game Theory Simulation.**

From the situation described above a sequential game can be extracted. It relates to the choice of engaging a Sports Centre and consequences of this option.



The graph above represents every possible outcome. Players: Project Team (1) and Sports Centre (2)  
 Strategies: (1) {Engage, Inform}; (2) {Help, Ignore}  
 Payoffs:  $U_1, U_2, U_3, \dots$  where  $U$  represents individual utility for each player choice. For example,  $U_1$  and  $U_3$  will be the values for the project team in terms of project results.

Assumptions: Sports Centre is more eager to help if project team actively engages it in the project, because that means keeping good relationships ( $U_2 > U_4$ )

Subgame perfect Nash equilibrium: {Engage; Help}

In this case Project Team has the first turn. By engaging Sports Centre as early as possible Project Team generates trust and start to build long term relationships. Otherwise choosing more passive strategy — informing about project updates, Project Team forces Sports Centre to pick dominant strategy ( $U_8 > U_6$ )

Sports Centre has the second turn. If it decides to ignore Project Team while they pick engage this may lead to the destruction of trust ( $U_7 < U_5$ ). By this I mean that Project Team and Sports Centre have already merged their goals and when sick manager returns to the workplace there will be a disagreement between him and other managers. Otherwise if Sports Centre decides to ignore project Team while they choose inform strategy, Sport Centre will lose nothing and even is going to save some time not helping.

Apart from the sequential game there is one more thing that kept things move forward. The letter from a Sports Centre that was shown to a group of people and made them left the room for a reception talk. This letter was a signal which demonstrated a clear intention to stay in the room.

**Further implications:**

1. Always engage key stakeholders as early as possible. They are extremely valuable for the final deliverables of small scaled projects.
2. Find the ways to generate trust for long term relationships to make another player choose the strategy which is the most beneficial for the project.
3. Be prepared to make signals for advancing your own strategy.

Fig. 4. Term 1 project

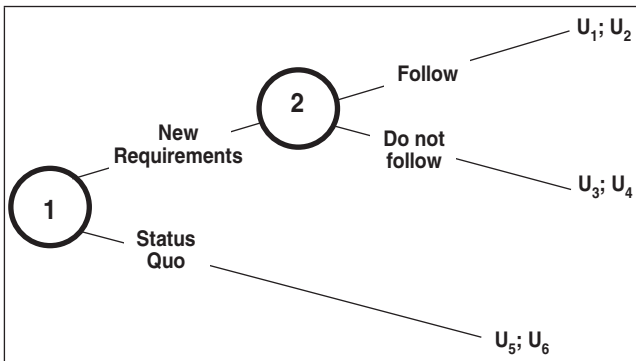
**Case 2**

**Situation description.** My term 2 experience can be described as a pure consultancy project. Our goal was to deliver the research report about the existing system of monitoring for charity in Morecambe. Then our team was also asked to develop a proposal with possible enhancements. Suddenly one of the stakeholders which was considered as very excited towards project deliverable, but could not affect it directly while being connected to the project supervisor, started to change his requirements and demanded more meetings. As we realized later the reason was involvement of this stakeholder into another small scaled project, far more important to him. This resulted into increased number of meetings that generate almost no value for our initial project. Described person also required our team to deal even more work with little relation to the project. In this moment we faced a dilemma: should the team execute new requirements or spend the time on more important project activities. In addition, our team also felt into a disagreement about the approach to the stakeholder considering his connection with project client. As the result we decided to ignore some of the requirements and tell directly our client about the situation. Client negotiated with a stakeholder and solved our problem of concentration.

**Game Theory Simulation.**

From the situation mentioned above one sequential game and one simultaneous game can be constructed. Sequential game relates to choice of following stakeholder requirement while the simultaneous is about internal team decision making.

Players: Stakeholder (1) and Project Team (2)  
 Strategies: (1) {New Requirements, Status Quo}; (2) {Follow, Do not follow}



Payoffs:  $U_1, U_2, U_3, \dots$  where  $U$  represents individual utility for each player choice

Assumptions: New Requirements has a little relation to project outcomes but will provide certain benefits for a stakeholder ( $U_1 > U_3$ ); Not following allows Project Team to concentrate more on the project ( $U_4 > U_2$ ). Subgame perfect Nash equilibrium: {New Requirements; Do not follow}

In this case it is obvious that both players will choose dominant strategies. Project Team will consider their initial task to have a higher priority than keeping good relationships with a stakeholder. Moreover, the project team can even make a threat that they are not going to follow new requirements and this threat will be credible ( $U_4 = U_6$ ).

Simultaneous game is far more interesting. It revolves around team members' disagreement (should we tell the client first or negotiate with annoying stakeholder first)

		2	
		Tell the project supervisor first	Negotiate with stakeholder first
1	Tell the project supervisor first	$(U_1; U_2)$	$(U_3; U_4)$
	Negotiate with stakeholder first	$(-; -)$	$(U_5; U_6)$

Players: Team member (1) and Team member (2)  
 Strategies: (1) & (2) {Tell the client first, Negotiate with stakeholder first}

Payoffs:  $U_1, U_2, U_3, \dots$  where  $U$  represents individual utility for each player choice

Assumptions: There is no trust between team members; Each team member considers his strategy to be the best option ( $U_4 > U_2$ ;  $U_3 > U_5$ ; no payoffs for different options); If both team members pick the same strategy the one with dominant choice gets more for insisting on his opinion;

Nash equilibrium: {Tell the client; Negotiate with stakeholder}

Let's assume this time we have a disagreement within the project team. Two active team members consider their choices the best for the project and literally start to compete. If one team member convinces other to pick the same strategy, his ego will be satisfied and the other will receive nothing. If they both do what they think is best, each team member will gain a less amount of satisfaction and this is going to be the game equilibrium. However, if we look on this game through the lens of project results and further commitment we will notice that such decision does not generate trust and even can lead to detrimental consequences. For instance, stakeholder might interpretate this disintegrated actions as out attempt to trick him and become harsher in interaction with the project team.

**Further implications**

1. Disagreements with external stakeholders lead to disagreements with internal ones
2. Credible threat should be timed. The earlier it is utilized the better
3. Signal tactic does not work without trust.
4. Project manager should realise the situations where the possible equilibrium might bring more harmful consequences and persuade team members to make the right decision

Fig. 5. Term 2 project

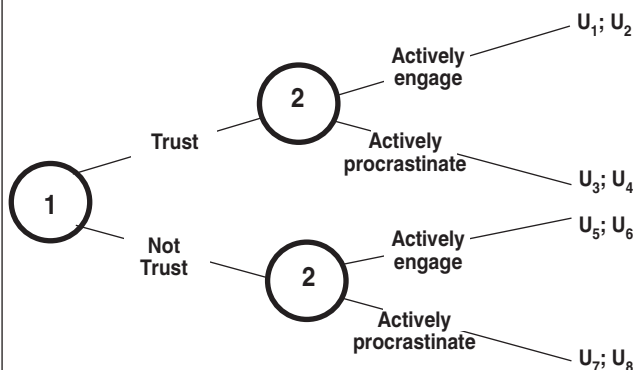
**Case 3**

**Situation description.** During Term 3 project we were involved into shooting the promotional clip for IT company in Lancaster. One of the objectives was to employ a qualified and at the same time affordable filming crew which will be able to create a high-quality product. Therefore, we have chosen a student from Lancaster University Arts department to become our videographer. Project initiation and planning stages were performed according to the plan. However, during the execution stage our team encountered an unexpected risk. Videographer was not motivated at all. He let himself miss the project meetings, ignore some of the emails, travelled to other countries, become ill. Due to his approach we could not complete the project earlier as originally planned and rescheduled several activities. Our client and supervisor noticed implemented changes in the management process and requested frequent meetings & detailed reports which

made project team more nervous. The solution was to negotiate the videographer’s payment with the client. To be more specific we have decided to split it in two parts — one should be paid after the shooting process and the second one after reviewing the draft. This gave a very strong motivation to the videographer and we still completed the project 4 days before the deadline.

**Game Theory Simulation**

From the situation mentioned above one sequential game can be constructed. This time the game also involves dealing with one Subgame perfect Nash equilibrium that should be moved to less optimal position according to the project results.



Players: Project Team (1) and Videographer (2)  
 Strategies: (1) {Trust, Not Trust}; (2) {Actively engage, Actively procrastinate}  
 Payoffs:  $U_1, U_2, U_3, \dots$  where  $U$  represents individual utility for each player choice  
 Assumptions: Procrastination gives videographer more satisfaction than the fair commitment because of information asymmetry ( $U_4 > U_2$ ); Not trust option involves certain incentives or penalties (both in the decision tree above) for procrastination ( $U_6 > U_8$ ); Active engagement is more valuable for the project results than procrastination ( $U_6 > U_7; U_1 > U_3$ ).  
 Subgame perfect Nash equilibrium: {Not trust; Actively engage}

The case depicted above is the example of information asymmetry and the following moral hazard. Videographer had more knowledge about the shooting process and possessed proper equipment. Therefore, he could let himself enjoy procrastination at our expense. Red lines on the decision tree demonstrate what happened in the beginning of the project, blue lines represent the best scenario for the team according to project results.

**Further implications**

1. Project manager should consider information asymmetry before making vital decisions
2. Trust is not always a good option in terms of project results
3. Making even a simple contract agreement before can greatly affect the payoffs and eliminate possible threats.

Fig. 6. Term 3 project

The outcomes from this section supports the second research question and provide a clear answer to the third one.

*4.4. Stakeholder Calibration Framework*

After collection the findings from literature review, In-Depth interviews and business cases we have gathered enough ideas to synthesis them into a new consistent framework that is going to demonstrate one of the possible ways to integrate Game Theory and project management. The final model is called: Stakeholder Calibration Framework (SCF) as reference to find or make a perfect equilibrium. The main purpose of SCF is to provide a new structured perspective to look on a stakeholder management combing already existed tools and techniques from interested parties’ analysis. There are several sequent stages to utilize SCF at full power which are presented below, as well as an example.

**Conventional stakeholder analysis.** As we identified from the semi-structured interviews (Chapter 4, Section 2) and PMBoK (Chapter 2, Section 3) traditional procedure to manage stakeholders in project management already contains some elements from Game Theory. By this I mean that it is necessary to list all project stakeholders (players), define their interests and values based on requirements (possible payoffs for the matrix or decision tree), rank them according to influence, support, predictability (assumptions), etc. and finally decide on the interaction strategy outlining communication approach (finding the equilibrium). Classic stakeholder mapping process gives us all necessary information to prepare for future games. Power/Interest grid from stakeholder identification stage mentioned in the PMBoK [38] clearly demonstrates one of the ways to predict the behaviour and prepare the response (Fig. 7). The only thing that should be added is recognising the number of threats or opportunities that each stakeholder might generate during the project completion.

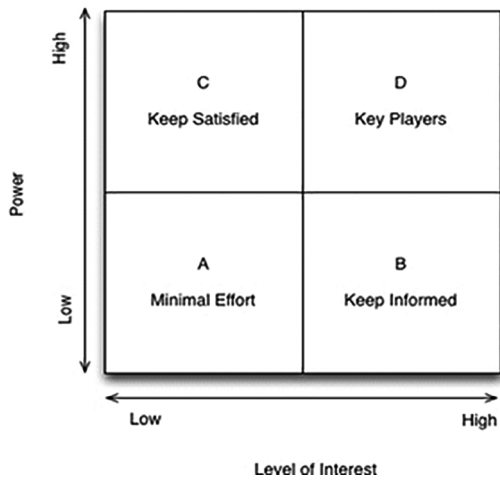


Fig. 7. Classic stakeholder mapping procedure

For example, from the situation described in the Term 2 project (Case 2, Fig. 5) it can be clearly seen that a stakeholder had a very high interest in the project result («being excited towards final deliverable») but possessed low power («could not affect directly the outcome»). According to power/interest grid our project team should've picked the B communication strategy (see Fig. 7). However, it did not appear as an optimal strategy and stakeholder started to annoy the project team with more requirements and frequent meetings that had no value for the final results. Therefore, after identifying basic stakeholder characteristics project manager should also take into account possible threats and opportunities of that interested party. In our example it can be the increasing stakeholder motivation to maximize his impact through continuous requests.

**Building the draft version of interaction net.** After key players are identified it is time to plan the set of games to perform from a side of a project manager. Since we know stakeholders power, interest, predictability and other important characteristics we are able to combine it with project goals and conclude on the general gaming approach. To specify, on this step project manager has to define with whom he is going to cooperate or to compete. Next thing is to visualise preliminary results. This can be done with a two dimensional model where horizontal axis represents allies while vertical one demonstrates competitors (Fig. 8). Level of influence can be represented by lines weight and the level of generated trust may be demonstrated by their length. The interaction net outlines the general relationships with various stakeholders and prepares the project manager for further games with the following decision making process. The example below demonstrates the possible

positions of external consultant, project sponsor, supplier, project team, project client and portfolio manager (see Fig. 8).

During deciding on gaming approach, it is necessary to take every piece of information available into consideration. If we take a closer look on the Term 2 project utilizing the concept of interaction map and positioning our stakeholder there, we may notice that the project manager will spend more efforts on trying to achieve win-win scenario, while benefits are still uncertain (low impact — little potential value of the stakeholder). Despite win-lose option seems more reliable and certain in terms of short-terms outcomes it is only our assumption that should be testified later. Thus it is reasonable to start from win-win gaming approach and analyse this position further.

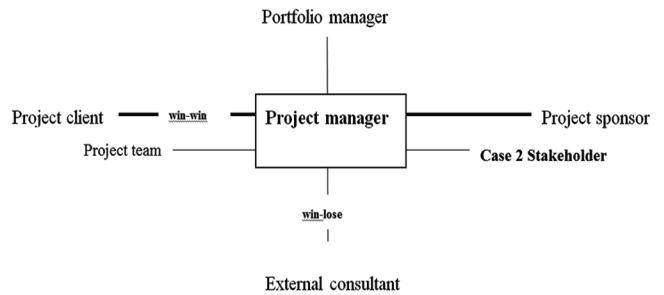


Fig. 8. The example of interaction net

**Game Theory simulation.** The next step is to perform Game Theory analysis based on the gathered data. Project manager has to select the stakeholder he is more interested in and construct a sequential or simultaneous game, recognising possible strategies, their consequences and outcomes for the project results (Chapter 4, Section 3 as the example of sequential and simultaneous games simulation). The goal of simulation is to identify the possible equilibrium in the game, asses it from the side of project performance indicators and decide whether it should be moved. This should be followed by writing an action plan consisting of various game-theoretic tactics involving the right utilization of signals, threats or trust to move the equilibrium to the preferred state. However due to lack of information in the initial phase project manager may experience the difficulties trying to understand the motivation of various stakeholders. This issue may be overcome by receiving stakeholder's feedback towards the consequences of their actions (Chapter 4, Section 1). To sum up, the simulation stage includes the following stages (Table 1):



Table 1

CHAPTER 5. CONCLUSIONS AND REFLECTIONS

Simulation algorithm

	Simulation step Description	Example Breakdown
e1	Choose a stakeholder to initiate a possible game	The stakeholder from Term 2 project
22	Gather all necessary information towards his requirements, values and goals utilizing the conventional stakeholder analysis. If it is not enough, receive his feedback about possible project threats (involves risks caused by this stakeholder) and rank them	<ul style="list-style-type: none"> <li>• Low impact</li> <li>• High Interest</li> <li>• Low predictability</li> <li>• Change requirements on a regular basis (possible threat — impact on the project results)</li> <li>• Connection to project supervisor</li> </ul>
33	Define the gaming approach and provide reasons for that. Win-win or win-lose	Win-win with a possible moving to win-lose + Clear short-term benefits in terms of concentration on actual deliverables, relieving the pressure and bonding alignment with project client.
44	Construct a sequential or simultaneous game to find the potential equilibrium	Sequential game from Fig. 5. Chance to achieve possible equilibrium via credible threat of using the project supervisor connection. The decision should be made to choose win-lose as the most optimal Game approach
55	Decide whether the equilibrium has to be moved and write an action plan	According to the sequential game breakdown equilibrium from the previous step is optimal. however it may cause the new simultaneous game with the project team

**Updating the existing value net.** The last step is to update the first version of the interaction net to show the impact of simulated games. As the project progresses and the uncertainty decreases the interaction net will become more and more applicable to make complex decisions. Stakeholder Calibration Framework will only work with frequent information updates and thorough benefits evaluation (Fig. 9).

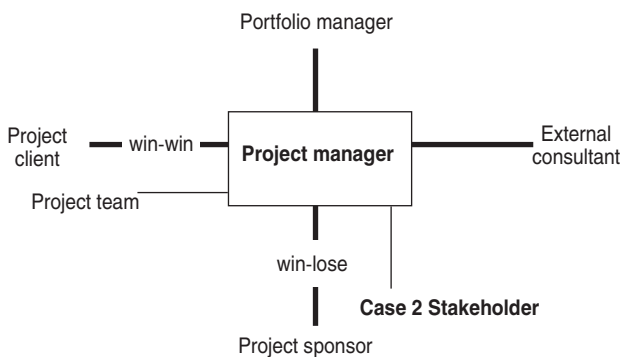


Fig. 9. Possible updates on the interaction net

Game Theory was originated to predict human behaviour and define people’s incentives under various circumstances. Projects are usually executed by people that use tools, models and techniques to achieve the result in a fast paced, uncertain and global environment. Implementing such project management concepts usually requires frequent interaction between various groups of people interested in the project outcomes. This raises an obvious question: why there not many studies combining Game Theory elements with project management procedures? Therefore, my research had a goal to close the gap between these two disciplines in a small scaled projects where people interaction is crucial for the final outcomes. The current research provides a set of insights into the field of Game Theory, project management and the beneficial combination of the two with respect to stakeholder analysis and project team dynamics.

To achieve the goal stated above I have formulated and answered three research questions involving the necessity of Game Theory in project management, assumptions and potential benefits from implementation and possible integration into existed procedure of stakeholder analysis. To conduct a research ethnographic approach was utilized in a four stage methodology involving such qualitative methods as critical literature review, in depth semi-structured interviews, project content analysis and business case building. Applying ethnographic approach to research can generate additional enthusiasm to continue the work further if you discuss the topic with as many experts as possible.

One of the main findings was that some of the Game Theory aspects are already applied in many areas of project management: risk analysis, stakeholder management, scheduling and project team dynamics. Another core result of the research was related to that the most project management situations in small-scaled projects can be easily deconstructed to classic games like prisoner’s dilemma or chicken game. Furthermore, a project manager may implement the same set of tactics to move the equilibrium to the preferred state. Taking every outcome into consideration the Stakeholder Calibration Framework (SCF) was developed to advance the existing process of stakeholder analysis further in game theoretic perspective. The research outcome shed the light on possible benefits that could be extracted from Game Theory (including both SCF and possible implications for similar small-scaled projects).

Describing the whole period of doing a research at Lancaster University on this particular topic I want to quote one of the participant's responses from the interview:

«We all make choices but in the end our choices make us».

To my mind, that is the brightest description of what happened to me during the research while studying MSc Project Management in Lancaster. To specify, I have learned and implemented lots of useful concepts that have transformed me into another person. For example, I have started to pay more attention to soft skills and realize they could be far more important than hard skills. This demonstrates the lack of attention that

is usually paid to stakeholder's interests and possible benefits.

One more important lesson was related to lots of valuable practical experience within the cross cultural teams playing different roles in three projects. I have not even noticed how my leadership style changed from a directive to more flexible and tolerant. Making analogy with the research topic, dominant strategies can be good only for a short-term but generally are detrimental to project results. Game theory once again underlines that projects are executed by people and should be managed not always according to the book. As a result, frequent project issues might be and has to be considered game-theoretic perspective.

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