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Knowledge friction in universities, approach from game theory

Fricción del conocimiento en instituciones de educación superior, planteamiento desde la teoría de juegos

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Abstract

In today's market economies, organizations see knowledge as one of their most valuable and strategic resources and seek to properly manage it so that it becomes a competitive advantage (Teece, 1988; Hamel and Prahalad, 1990, Drucker, 1994; Nonaka and Takeuchi, 1995; Boisot, 1998; Spender, 1996; Senge, 1990). Although many organizations make significant investments in technology and tools to promote knowledge sharing, cultural, behavioral, and structural aspects are the main determinants of success (Sharma and Bhattacharya, 2013). Organizational knowledge processes are, by their nature, generally social and complex. The behaviors related to sharing knowledge of organizational agents are full of situations of conflict of interest or dilemmas in which they receive different payments based on their strategic decisions. Such situations can be modeled as games. This article presents the approach to a particular dilemma, that of the knowledge friction in an Institution of Higher Education through Game Theory, describing a non-cooperative game model that allows showing the scope of said situation according to the decisions considered to be done by employees and employer and their related payments, exploring different decision-making scenarios.

Knowledge management, game theory, knowledge dilemmas

Resumen

En las economías de mercado actuales, las organizaciones ven al conocimiento como uno de sus más valiosos y estratégicos recursos y buscan manejarlo adecuadamente para que se convierta en ventaja competitiva (Teece, 1988; Hamel y Prahalad, 1990, Drucker, 1994; Nonaka y Takeuchi, 1995; Boisot, 1998; Spender, 1996; Senge, 1990). Aunque muchas organizaciones hacen inversiones significativas en tecnología y herramientas para promover la compartición de conocimiento, son los aspectos culturales, de comportamiento y estructurales los principales determinantes del éxito (Sharma y Bhattacharya, 2013). Los procesos de conocimiento organizacional son, por su naturaleza, generalmente sociales y complejos. Los comportamientos relacionados con compartir conocimiento de agentes organizacionales están llenos de situaciones de conflicto de intereses, o dilemas, en los que ellos perciben diferentes pagos basados en sus decisiones estratégicas. Dichas situaciones pueden ser modeladas como juegos. Este artículo presenta el planteamiento de un dilema en particular, el de la fricción del conocimiento en una Institución de Educación Superior a través de Teoría de Juegos describiendo un modelo de juego no cooperativo que permite mostrar los alcances de dicha situación acorde a las decisiones de empleados y empleador y los pagos relacionados, explorando diferentes escenarios de tomas de decisión.

Gestión del conocimiento, Teoría de juegos, dilemas del conocimiento

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Introduction

In today's complex and globalized market economies, organizations see knowledge as one of their most valuable and strategic resources and seek to manage it properly so that it becomes a competitive advantage (Teece, 1988; Hamel and Prahalad, 1990, Drucker, 1994; Nonaka and Takeuchi, 1995; Boisot, 1998; Spender, 1996; Senge, 1990). Although many organizations make significant investments in technology and tools to promote knowledge sharing, cultural, behavioral, and structural aspects are the main determinants of success (Sharma and Bhattacharya, 2013).

Organizational knowledge processes are, by their nature, generally social and complex. One of the biggest challenges in Knowledge Management is behavior change related to the creation and consumption of knowledge.

The flow of knowledge refers to the links between creation and consumption and occurs at two levels: the intra-organizational level, which occurs within the limits of the organization; and the interorganizational level, which extends outside the organization and includes external entities such as suppliers, alliances, business partners, competitors, and industry regulators (Sharma and Bhattacharya, 2013).

Behaviors related to sharing knowledge of organizational agents (knowledge of employees) are fraught with situations of conflict of interest in which they receive different payments based on their strategic decisions. Such situations can be modeled as games. This article presents the approach to a particular dilemma, that of the friction of knowledge in an Institution of Higher Education through Game Theory, describing a non-cooperative game model that allows showing the scope of said situation according to the decisions made. are considered and related payouts in the game described.

Knowledge Dilemmas

The Organizational Knowledge Ecosystem includes situations where agents, as creators and consumers of knowledge, make strategic decisions to derive the best possible results for the organization, however, the search for personal or group interests may conflict with the interests of the organization. organization (Sharma and Bhattacharya, 2013). This is particularly true in organizations such as Institutions of Higher Education. Mutual dependence on such alternatives can lead to undesirable payoffs for some or all stakeholders. To capture and articulate the essence of such complexity in decision making, the notion of dilemma is introduced into the knowledge ecosystem.

A Dilemma is understood as a situation in which it is necessary to choose between apparently undesirable alternatives. Knowledge Dilemmas are situations of conflict of interest, mainly, that can be specified through multiple perspectives and levels, both strategic, implementation, cultural, economic and political. Some key knowledge dilemmas that characterize situations of conflict of interest between agents of the organization are the Silos of knowledge, The Tragedy of the public good, Frictions of knowledge and the toxicity of knowledge.

Regarding these dilemmas, the main factors involved include aspects such as the perception of power that knowledge grants (Sharma and Bhattacharya, 2013), the acceptance of other employees, the prestige of those involved and decisions related to the effort to carry out knowledge sharing tasks.

It is difficult to measure the recognition of an employee, and even more so his social prestige. In general, an employee is said to have a certain social value when he offers something that society appreciates and considers important. In addition, public opinion considers that this recognition should be rewarded with a salary level in accordance with the work performed (Vaillant, 2007).

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An important factor to consider in the analysis of the teacher's situation as an employee of an Educational Institution is the respect or prestige they enjoy, because it will depend on whether they find more or less difficulties in the development of their tasks (Vaillant, 2007).

Game Theory for Knowledge Management

Games are taxonomies of strategic situations. Game Theory is a mathematical derivation that analyzes the cognitive abilities of the player's strategies (Camerer, 2003). The main objective of theoretical reasoning for games is not to predict the outcome of the game, but to discover how the game is played and how rational players who pursue their own interests are likely to make strategic decisions in response to the strategies of other participating players (Polak, 2007).

The rationality assumption suggests that knowledge workers pursue their individual interests while playing in the organizational knowledge ecosystem. Often, according to Adam Smith's "invisible hand" theory, individual interests gained through their "best responses" are expected to lead to superior results for the organization (Sharma and Bhattacharya, 2013). Therefore, game models that describe knowledge dilemmas could be structured as non-cooperative in nature. The knowledge dilemma explored in this study implies a tension between the best for the organization and the conflict of interest (Sharma and Bhattacharya, 2013).

Knowledge is a resource that does not diminish and knowledge transactions offer potential winning opportunities for all participants (Sharma and Bhattacharya, 2013). From a game modeling perspective, such situations are conceptualized as variable sum. In terms of research approach, this paper takes advantage of simple models offered by Game Theory, such as the exclusive “Principal-Agent” game model. For simplicity, only two-player games are considered.

Considerations for applying Game Theory

Game Theory of behavior suggests that factors such as history and culture influence the actual behavior of human agents in social situations (Camerer, 1997; Camerer, 2003; Dufwenberg, 2004). Game theory researchers also recognize the role of a critical mass of human agents in initiating change in the social behavior of a group (Dixit and Nalebuff, 2008). The themes of communality and conflict of interest proposed by game theorists are congruent with theories of social exchange and collective action, in relation to the organizational knowledge ecosystem (Ghobadi and D’Ambra, 2011).

The dominant individual rationality implies retaining the monopoly of knowledge through hoarding (Chua, 2003) considering knowledge associated with the perception of power. In multi-unit organizations, the asymmetry of knowledge repositories, authorities, structural and cultural arrangements between units can result in a poor flow of knowledge (Tsai, 2002; Gupta and Govindarajan, 2000). Additionally, the asymmetry of information in knowledge exchanges impairs the flow of knowledge in organizations (Davenport and Prusak, 1998).

The flow of knowledge in organizations depends heavily on the creation of new knowledge through voluntary contribution and the transfer of such knowledge by sharing it to be used as needed (Sharma and Bhattacharya, 2013). However, when the possession of knowledge is associated with a sense of holding power, knowledge agents may not be willing to share it. Instead, knowledge agents make decisions about the investments of limited time and effort required to exchange knowledge based on the interests they perceive as their own (Davenport and Prusak, 1998). In this way, knowledge sharing situations reflect conflicts of interest, where individuals make strategic decisions between contributing or accumulating their knowledge depending on the benefits perceived in the exchanges (Sharma and Bhattacharya, 2013).

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The asymmetry of information in knowledge exchanges can spread inefficiency throughout the knowledge ecosystem (Davenport and Prusak, 1998; von Hippel, 1994; Hansen and Nohria, 2004). This information asymmetry affects the perceived value of knowledge by the receiver and consequently, the effectiveness of the knowledge flow. Knowledge exchanges generally occur with incomplete information between two players: the knowledge seeker and the knowledge provider; Furthermore, there are operational inefficiencies in knowledge transfer because the nature of knowledge and its value is uncertain in the sharing stage (Sharma and Bhattacharya, 2013). Together, the three problem areas contribute to a dilemma that affects the process of knowledge creation and sharing in the organization, producing disaggregated knowledge packages or knowledge silos.

Knowledge friction

As organizations seek to compare their knowledge and replicate best practices within their limits, such knowledge transfer may be inhibited by contingent factors such as similarity of context, motivational disposition, strength of relationships, and absorptive capacities (Szulanski, 1996; O 'Dell and Grayson, 1998; Argote and Ingram, 2000; Perrin, Rolland and Stanley, 2007). In this sense, a game is proposed contemplating the lack of adoption of organizational knowledge as a representation of the Friction Dilemma of knowledge.

Methodology

The information used to propose the scenarios and games that are developed below are based on the professional experience of ten years of members of an Educational Institution and the participation in different projects related to the sharing of knowledge in professional services, participatory observation and non-participatory, and relationships with stakeholders. The modeling of the game is proposed based on different scenarios that are described from elements of Game Theory.

Dimension	Key questions for game analysis	Implications for the knowledge ecosystem
Players	Who are the players in the game?	In an organizational ecosystem, the players are all the members involved in knowledge processes such as knowledge creation, transfer and application. In the case of analysis, the players are: the Director of a Division and the "Agent" (research professor) required for the task of sharing knowledge in a project.
Value added	What is the additional value that each player brings to the game over the other players?	In an organizational context, the reputation or prestige of an employee who is a source of knowledge can add value for him (Sharma and Bhattacharya, 2013) and influence the success of the project.
Rules	Are the rules fixed or are they manipulable? In the case of the proposed game, the Director has the power to set the rules. In a strategic sense, the player who makes the first move can create advantage for himself, as in the case of the proposed game.	In an organizational knowledge ecosystem, there is no set of universal rules. They can be organizational policies that require knowledge contribution as an evaluation criterion. But in practice, it is the organizational culture that determines whether some of the dilemmas permeate the entire organization.
Tactics	What is the perception of the different players in the game? Players' perception of the game is one of pure competition (win-lose) and influences the tactics that players will adopt in the game.	Under what circumstances do players (co) create, transfer and apply knowledge to maximize their payouts. These constitute the set of tactics to formulate.
Scope	What is the scope of the game? The scope is set by the Director in terms of the delimitation of the factors to be considered for payments and the choice of agent based on prestige.	The scope of the game is limited to the barriers of the organization. The scope of the game can be changed by allowing cross-organizational knowledge flows such as partnerships, alliances, and outsourcing.

Table 1 Dimensions and implications for game analysis
Source: Own elaboration based on Sharma and Bhattacharya (2013)

As described in Table 1, the additional value that each player brings to the game with respect to the other players can include aspects such as the prestige, acceptance and perception of value of the knowledge to be shared. This suggests how players can increase their own profits and limit the payouts of other players, for example, by distinguishing between those of higher and lower prestige.

If one or more players have the power to manipulate the rules using strategic moves, it impacts the added value and tactics of the players (Sharma and Bhattacharya, 2013). In a strategic sense, the player who makes the first move can create advantage for himself. In an organizational knowledge ecosystem, there is no set of universal rules, (Sharma and Bhattacharya, 2013), they can be organizational policies that require knowledge contribution as an evaluation criterion. But in practice, it is the organizational culture that determines whether some of the dilemmas permeate the entire organization (Sharma and Bhattacharya, 2013).

Regarding the scope of the game, players can change it by expanding or reducing the boundaries of the game.

Dimension	Key questions for game analysis
Players	Organizational leadership that intends to disseminate knowledge-based practices or assets within the organization and to the employees or groups involved in sharing such knowledge.
Value added	Leadership can add value by formulating appropriate incentive schemes according to the level of effort of employees and their prestige and by limiting the added value of employees through incentives subject to project results.
Rules	Fixed rules like work agreements. However, reinforcing the adoption of knowledge-based practices through contractual arrangements is not entirely feasible in the context of an organization.
Tactics	Players related to the adoption of certain knowledge perceive the activities linked to additional effort levels and evaluate the payments of additional efforts against the incentives offered to them for such activities.
Scope	Game boundaries can range from small groups to the entire organization.

Table 2 Dimensions of the Friction of Knowledge game
Source: Own elaboration based on Sharma and Bhattacharya (2013)

Strategic situation (game model)

Strategic parameters for modeling: Two player game, sequential movement, variable sum game

As suggested in the knowledge friction dilemma, management's best interest is achieved through the transfer and application of organizational knowledge throughout the company. However, the actions of groups involved in the practice of such objectives may not be aligned with the organizational good. Therefore, a strategic situation arises due to the sticky nature of knowledge. It is generally difficult, if not impossible for the organization to monitor and control the application of knowledge (particularly the transfer and reuse of valuable tacit knowledge and relational capital) (Sharma and Bhattacharya, 2013). In Game Theory, this situation with endogenous uncertainty, where a player is unable to observe the actions that another player takes, is called "moral hazards" or "moral risk", that is, the conflict of collective knowledge where no one feels responsible. In the scenarios proposed, the Director cannot monitor each of the agent's actions, so he decides to act based, not on the process, but on the final results.

From a Game Theory perspective, it seeks to analyze the scenario and build effective incentive mechanisms that can cause teams to act in line with the best interest of the ecosystem. The reference model is the "Principal-Agent" in which a manager (Principal) hires an employee (Agent) to carry out a project. In this case, the Principal represents the Director of a Division of a Higher Education Institution and the agent represents a professor in charge of sharing knowledge from the completion of a project. Both the manager and the employee can choose two strategies and there are two consequences for each employee action:

The Director (“Principal”) decides the level of compensation to offer the employee:

R (fixed compensation)

R’ (salary plus incentive depending on the result of the project)

R_P (salary plus incentive depending on the prestige of the agent)

R'_P (salary plus incentive depending on the prestige of the agent and the result of the project)

When the employee is chosen by the Director, and the project is assigned, he must make two important decisions: working to be accepted and the level of effort that will be put into the project.

The employee responds to the manager's decision by applying a greater or lesser effort to be accepted in the group to which he will transmit the knowledge. If the employee has prestige:

A_{YY} (greater effort)

A_{YN} (less effort)

If the employee does not have prestige:

A_{NY} (greater effort)

A_{NN} (less effort)

Once the employee makes this decision, they must decide whether to apply more or less effort to the assigned project:

W_H (greater effort)

W_L (less effort)

The employee chooses after the manager's decision and his decision is not clear and observable to the manager. The manager cannot judge the employee's efforts, so the incentive payment is given with respect to how observable results or prestige may be, or a combination of both. Therefore, the Director's net payments include the two possible levels: G and B.

From the perspective of earnings from payments, these can be expressed as a function of incentives: U(R) or U(R') or $U(R_P)$ or $U(R'_P)$ depending on the type of incentive to pay.

However, payments should be tied to perceived dissatisfaction (or disutility) for the level of effort the employee needs to spend (the difficulty) of achieving the incentive. Assuming this disutility as dH when the employee makes a great effort and dL when the employee makes less effort, the net payments for the employee are given at the levels given by the different profits that are generated in each proposed scenario.

From the concept of "nature" or serendipity, which determines the additional profitability to the employee's selected strategy, it is considered that for each project, there is a probability that said project will be good or successful, or bad, due to circumstances that are outside of the players' decisions, for which probabilities associated with the success or failure of the projects are added:

p and (1-p) for the case of the election of prestigious employees.

q and (1-q) in the case of the election of employees without prestige.

Type	Symbol	Variable	Meaning
Gain	G	Good Project Gain	Profit obtained from a good project, which can be translated into money or in kind, such as download hours for projects, incentives for publications or attendance at conferences, among others.
	B	Bad Project Gain	Profit obtained from a bad project.
Payment scheme chosen by the Director	R	Fixed payment	Fixed payment scheme, independent of the level of profit of the project and the prestige of the employee.
	R '	Payment based on the profit obtained from the project	Payment scheme based on the profit obtained in project G or B.
	R_P	Pay based on prestige	Payment scheme based on the prestige of the PS or PN employee where the result of the project is not considered.

	R'_P	Pay based on prestige and profit	Payment scheme based on the prestige of the employee and the profit obtained in project G or B.
Employee prestige	P_Y	Prestigious employee	Employee with a prestigious level.
	P_N	Employee without prestige	Employee without prestige for the project.
Acceptance stress factor	A_Y	Effort factor to be accepted	Effort factor that the employee applies to be accepted by the other employees to whom he will share the knowledge.
	A_N	Factor of no effort to be accepted	No effort factor that the employee does not apply to be accepted by the other employees to whom they will share the knowledge. This factor negatively impacts the effort you will have to have in carrying out the project.
Utility for the employee	U	Employee profit	Profit generated by the payment granted by the Director.
Employee disutility	d_H	High disutility	Disutility perceived by the employee as high due to the high effort applied to obtain the desired profit. It is a perception of loss by the employee.
	d_L	Low disutility	Disutility perceived by the employee as low due to the low effort applied to obtain the desired profit. It is a perception of loss on the part of the employee.
	N	Prestige level	Level of prestige that the employee obtains for a good project or that he loses for a bad project.
	p	Probability of success for PY	Probability of success when there is prestige
	q	Probability of success for PN	Probability of success when there is no prestige

Table 3 Variables and descriptors
Source: Self made

From the theoretical analysis of the variables and the game conditions observed in reality, the conditions of Table 4 are proposed.

Condition	Interpretation
G>B	A good project has a greater profit than a bad project.
B>R	Profit from a bad project should at least be able to pay for the employee incentive.
$1>A_{YY}>A_{YN}>A_{NY}>A_{NN}$	Accepting an employee implies less effort to share knowledge.
$R_G > R_B$	The incentive for a good project is greater than the incentive for a bad project.
$d_H > d_L$	A greater effort is perceived by the employee as a higher disutility than a lesser effort. Employee perceived value will always be high when they try less.
$R_{PY} > R_{PN}$	The incentive to pay based on prestige is greater for a more prestigious employee.
$R_{PG} > R_G > R_{PG} > R_{PB}$ $R_{PB} > R_B$	The incentive to pay based on prestige and profit is greater for a more prestigious employee on a project that goes well.
p > q	The probability of a project going well is higher for a prestigious employee than for a non-prestigious employee.

Table 4 Conditions for the game
Source: Self made

Assumptions in the different scenarios

Scenario 1) Fixed payment (R) per project

This scenario raises the Director's proposal to make a fixed "payment" for the project, regardless of whether it goes wrong or not, or the effort applied or the level of prestige that the employee possesses. Each employee choice has an impact on the profit of the project. Since the Director cannot judge the employee's efforts, he will pay the incentive based on the profitability achieved (R), so the Director's profit will be determined by how well the project succeeds.

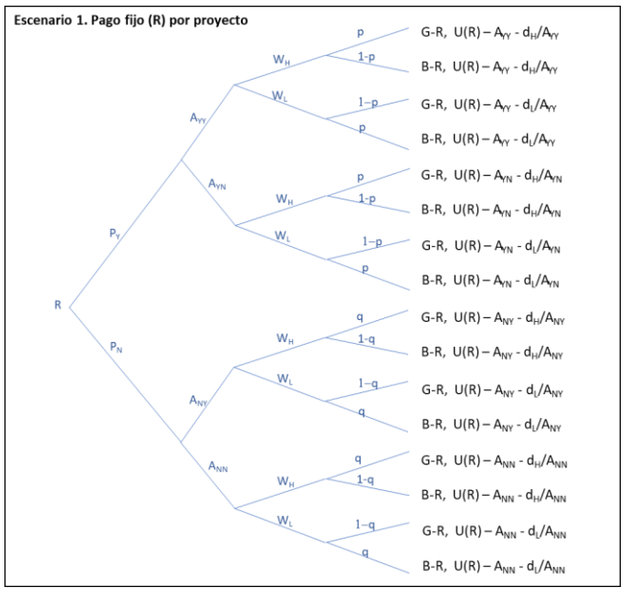

Figure 1 Game tree for Scenario 1 Fixed pay (R) per project
Source: Own elaboration

Knowledge is considered a public good with its "non-exclusion" and "non-rivalry" characteristics, and, like all public good, it is susceptible to underinvestment (Sharma and Bhattacharya, 2013). As the consumption of knowledge can be enjoyed without any contribution, the strategy of maximizing benefits for any agent in the organization is the "free ride" (Hardin, 1993; Cabrera, 2002). This leads to a suboptimal for the organizational knowledge ecosystem and presents a social dilemma (Sharma and Bhattacharya, 2013). This dilemma leads to a paradoxical situation where individual rationality towards the maximization of self-interest leads to collective irrationality in the overexploitation of common resources, producing a suboptimal for the entire organization. This situation is identical to the "Tragedy of the public good", for the sharing of public goods described by Hardin (1993) and popularized by Lessig (2002), so it can be considered under this type of game. Knowledge agents or players must decide how much of the knowledge they possess to invest in sharing it so that everyone "enjoys" that knowledge (common welfare).

Each player has a pool of knowledge ei that they can contribute (invest) and each player must decide how much of this knowledge they will share (invest) gi: $0 \leq gi \leq ei$. The payment function of player i is given by: ei - gi, which are the player's personal interest investments.

We assume the same amount of knowledge that can be shared, for each player, which will be reflected in the effort W that the player includes in carrying out the project.

The net payments for the "Principal" in the two levels are, respectively:

G - R

B – R

From the perspective of earnings from payments, these can be expressed as a function of incentives:

U (R) for a good gain or bad gain scenario.

However, payments should be tied to perceived dissatisfaction (or disutility) for the level of effort W that the employee needs to spend (the difficulty) of achieving the incentive. Assuming that disutility as dH when the employee puts in a great effort and dL when the employee tries less, the net payments to the employee at the two levels are, respectively:

$U(R) - d_H$

$U(R) - d_L$

Scenario Solution 1

To solve this dynamic non-cooperative game with complete information, it is necessary to compare the payouts based on the last decisions made, that is, "backwards".

It begins by comparing the corresponding payments for a prestigious employee. Pay 1 (PY, AYY, WH) is compared with pay 2 (PY, AYY, WL), corresponding to the decision of an employee with prestige PY who strives to be accepted AYY, between investing a greater effort WH or a less effort WL.

The payment equations:

$$Y_{ij} = \alpha + \sum_{h=1}^{r} \beta_h X_{hij} + u_j + e_{ij}$$

$$p\left[UR - A_{YY} - \frac{d_H}{A_{YY}}\right] + (1-p)\left[UR - A_{YY} - \frac{d_H}{A_{YY}}\right]$$

Strategy (P_Y, A_{YY}, W_H) (1)

$$(1-p)\left[UR - A_{YY} - \frac{d_L}{A_{YY}}\right] + p\left[UR - A_{YY} - \frac{d_L}{A_{YY}}\right]$$

Strategy (P_Y, A_{YY}, W_L) (2)

Simplifying (1) $UR - A_{YY} - \frac{d_H}{A_{YY}}$

Simplifying (2) $UR - A_{YY} - \frac{d_L}{A_{YY}}*$

As $-\frac{d_H}{A_{YY}} < -\frac{d_L}{A_{YY}}$, a larger number is subtracted in payment 1 so that payment 2 obtains a higher utility.

Now pay 3 (PY, AYN, WH) is compared with pay 2 (PY, AYN, WL), corresponding to the decision of an employee with prestige PY who does not strive to be accepted AYN, between investing a greater effort WH or less effort WL.

The payment equations:

$$p\left[UR - A_{YN} - \frac{d_H}{A_{YN}}\right] + (1-p)\left[UR - A_{YN} - \frac{d_H}{A_{YN}}\right]$$

Strategy (P_Y, A_{YN}, W_H) (3)

$$(1-p)\left[UR - A_{YN} - \frac{d_L}{A_{YN}}\right] + p\left[UR - A_{YN} - \frac{d_L}{A_{YN}}\right]$$

Strategy (P_Y, A_{YN}, W_L) (4)

Simplifying (3) $UR - A_{YN} - \frac{d_H}{A_{YN}}$

Simplifying (4) $UR - A_{YN} - \frac{d_L}{A_{YN}}*$

As $-\frac{d_H}{A_{YN}} < -\frac{d_L}{A_{YN}}$, a larger number is subtracted in payment 3 so that payment 4 obtains a higher utility.

Now the corresponding payments are compared for the case of an employee without prestige. Pay 5 (PN, ANY, WH) is compared with pay 6 (PN, ANY, WL), corresponding to the decision of an employee without prestige PN who strives to be accepted ANY, between investing a greater effort WH or a less effort WL.

The payment equations:

$$p\left[UR - A_{NY} - \frac{d_H}{A_{NY}}\right] + (1-p)\left[UR - A_{NY} - \frac{d_H}{A_{NY}}\right]$$

Strategy (P_N, A_{NY}, W_H) (5)

$$(1-p)\left[UR - A_{NY} - \frac{d_L}{A_{NY}}\right] + p\left[UR - A_{NY} - \frac{d_L}{A_{NY}}\right]$$

Strategy (P_N, A_{NY}, W_L) (6)

Simplifying (5) $UR - A_{NY} - \frac{d_H}{A_{NY}}$

Simplifying (6) $UR - A_{NY} - \frac{d_L}{A_{NY}}*$

As $-\frac{d_H}{A_{NY}} < -\frac{d_L}{A_{NY}}$, a larger number is subtracted in payment 5 so that payment 6 obtains a higher utility.

Pay 7 (PN, ANN, WH) is compared with pay 8 (PN, ANN, WL), corresponding to the decision of an employee without prestige PN who does not make an effort to be accepted ANN, between investing a greater effort WH or less effort WL.

The payment equations:

$$p\left[UR - A_{NN} - \frac{d_H}{A_{NN}}\right] + (1-p)\left[UR - A_{NN} - \frac{d_H}{A_{NN}}\right]$$

Strategy (P_N, A_{NN}, W_H) (7)

$$(1-p)\left[UR - A_{NN} - \frac{d_L}{A_{NN}}\right] + p\left[UR - A_{NN} - \frac{d_L}{A_{NN}}\right]$$

Strategy (P_N, A_{NN}, W_L) (8)

Simplifying (7) $UR - A_{NN} - \frac{d_H}{A_{NN}}$

Simplifying (8) $UR - A_{NN} - \frac{d_L}{A_{NN}}*$

As $-\frac{d_H}{A_{NN}} < -\frac{d_L}{A_{NN}}$, a larger number is subtracted in payment 7 so that payment 8 obtains a higher utility.

Regarding the decisions of the prestigious employee, now PS must decide whether to choose AYY or AYN

The simplified payment equations are:

$$UR - A_{YY} - \frac{d_L}{A_{YY}} \quad (2)$$

$$UR - A_{YN} - \frac{d_L}{A_{YN}} \quad (4)$$

We proceed to compare:

$-A_{YY} - \frac{d_L}{A_{YY}}$ y $-A_{YN} - \frac{d_L}{A_{YN}}$

As $A_{YY} > A_{YN}$ but $\frac{d_L}{A_{YY}} < d_L/A_{YN}$ subscenarios arise based on the acceptance factor.

As the acceptance factor significantly impacts the effort and therefore the disutility perceived by the employee:

When the acceptance factor is high:

$$A_{YY} > A_{YN} + \left(\frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}\right)$$

The impact on disutility is less so it will subtract less from utility and (2) will be chosen.

When the acceptance factor is low:

$$A_{YY} < A_{YN} + \left(\frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}\right)$$

The impact on disutility is greater so it will subtract more from the utility and it will be chosen (4).

When $A_{YY} = A_{YN} + \left(\frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}\right)$ you can choose either of the two payments because they will be worth the same.

As for the decisions of the employee without prestige, now PN must decide whether to choose A_{YY} or A_{YN}

The simplified payment equations are:

$$UR - A_{NY} - \frac{d_L}{A_{NY}}* \quad (6)$$

$$UR - A_{NN} - \frac{d_L}{A_{NN}}* \quad (8)$$

We proceed to compare:

$-A_{NY} - \frac{d_L}{A_{NY}}$ y $-A_{NN} - \frac{d_L}{A_{NN}}$

As $A_{NY} > A_{NN}$ but $\frac{d_L}{A_{NY}} < d_L/A_{NN}$ subgames arise based on the acceptance factor.

As the acceptance factor significantly impacts the effort and therefore the disutility perceived by the employee:

When the acceptance factor is high:

$$A_{NY} > A_{NN} + \left(\frac{d_L}{A_{NY}} - \frac{d_L}{A_{NN}}\right)$$

The impact on disutility is less so it will subtract less from utility and will be chosen (6).

When the acceptance factor is low:

$$A_{NY} < A_{NN} + \left(\frac{d_L}{A_{NY}} - \frac{d_L}{A_{NN}}\right)$$

The impact on disutility is greater so it will subtract more from the utility and it will be chosen (8).

When $A_{NY} = A_{NN} + \left(\frac{d_L}{A_{NY}} - \frac{d_L}{A_{NN}}\right)$ you can choose either of the two payments because they will be worth the same.

Now the Director decides whether to elect PY or PN. For the Director, the incentive to pay is the same but its utility is not, since p and q are different (p> q). This is because an employee with higher prestige is more likely to obtain a better result from a project than an employee with less prestige as stated in the Theory and has been observed empirically.

Payments for the Director are:

(P_Y) p(G-R) + (1-p) (B-R)

(P_N) q(G-R) + (1-q) (B-R)

Simplifying:

(P_Y) pG + (1-p) B
(P_N) qG + (1-q) B

As p>q but (1-p) < (1-q), the payments will depend on the values that p and q take:

When $G > \frac{[qG+(1-q)G-(1-p)B]}{p}$ will be chosen P_Y

When $G < \frac{[qG+(1-q)G-(1-p)B]}{p}$ will be chosen P_N

When $G = \frac{[qG+(1-q)G-(1-p)B]}{p}$ you can choose either of the two payments because they will be worth the same.

So the solution of the game would be:

When $G > \frac{[qG+(1-q)G-(1-p)B]}{p}$

The dominant Strategy would be PY, AYY, WL When the acceptance factor is high $A_{YY} > A_{YN} + \left(\frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}\right)$

The dominant Strategy would be PY, AYN, WL When the acceptance factor is low $A_{YY} < A_{YN} + \left(\frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}\right)$

When $A_{YY} > A_{YN} + \left(\frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}\right)$ you can choose either of the two strategies because the payouts will be worth the same.

When $G < \frac{[qG+(1-q)G-(1-p)B]}{p}$

The dominant Strategy would be PN, ANY, WL When the acceptance factor is high $A_{NY} > A_{NN} + \left(\frac{d_L}{A_{NN}} - \frac{d_L}{A_{NY}}\right)$

The dominant Strategy would be PN, ANN, WL When the acceptance factor is low $A_{NY} < A_{NN} + \left(\frac{d_L}{A_{NN}} - \frac{d_L}{A_{NY}}\right)$

When $A_{NY} = A_{NN} + \left(\frac{d_L}{A_{NY}} - \frac{d_L}{A_{NN}}\right)$ you can choose either of the two strategies because the payouts will be worth the same.

When $G = \frac{[qG+(1-q)G-(1-p)B]}{p}$ You can choose either of the PY or PN strategies with the winning payments for the employee, because the Director's payments will be worth the same.

Scenario 2. Payment plus incentive (R ') based on the profitability of the project

In the case of this scenario, each employee option has an impact on the profit of the project depending on the profitability of the project.

Since the manager cannot judge the employee's efforts, he will pay the incentive based on the profitability achieved, so the incentive will be based on whether the project had a good or a bad profit. For example, the manager pays:

– An incentive from RG When the earning level is G and

– An incentive from RB When profit is B

– Therefore, the net payments to the manager at the two levels are, respectively:

G - RG

B - RB

From the perspective of earnings from payments, these can be expressed as a function of incentives:

U (RG) for a good gain scenario

U (RB) for a bad gain scenario

However, payments should be tied to perceived dissatisfaction (or disutility) for the level of effort the employee needs to spend (the difficulty) of achieving the incentive. Assuming that disutility as dH When the employee puts in a lot of effort and dL When the employee puts in less effort, the net payments for the employee at the two levels are, respectively:

$U(R_G) - d_H$

$U(R_B) - d_L$

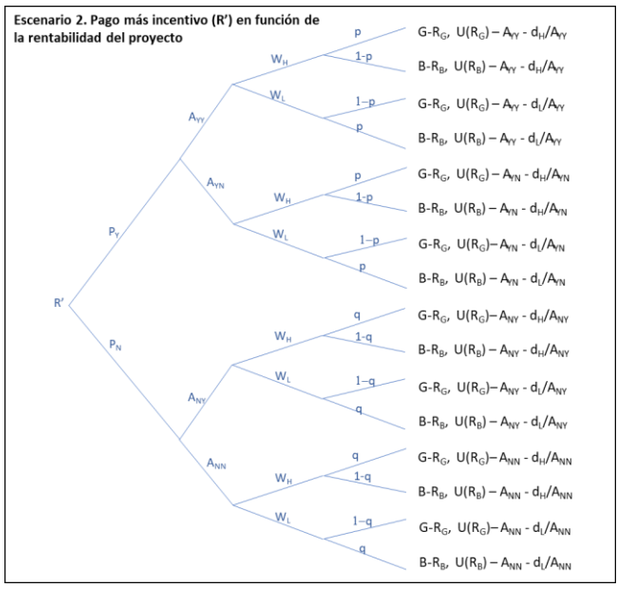

Figure 2 Game tree for Scenario 2 Payment plus incentive (R ') based on the profitability of the project
Source: Self-made

Scenario Solution 2

To solve this dynamic non-cooperative game with complete information, you start by comparing the corresponding payouts for a prestigious employee.

Pay 1 (PY, AYY, WH) is compared with pay 2 (PY, AYY, WL), corresponding to the decision of an employee with prestige PY who strives to be accepted AYY, between investing a greater effort WH or a less effort WL.

The payment equations:

$$p\left[UR_G - A_{YY} - \frac{d_H}{A_{YY}}\right] + (1-p)\left[UR_B - A_{YY} - \frac{d_H}{A_{YY}}\right]$$

Strategy (P_Y, A_{YY}, W_H) (1)

$$(1-p)\left[UR_G - A_{YY} - \frac{d_L}{A_{YY}}\right] + p\left[UR_B - A_{YY} - \frac{d_L}{A_{YY}}\right]$$

Strategy (P_Y, A_{YY}, W_L) (2)

Simplifying (1) $pUR_G + (1-p)UR_B - A_{YY} - \frac{d_H}{A_{YY}}$

Simplifying (2) $(1-p)UR_G + pUR_B - A_{YY} - \frac{d_L}{A_{YY}}$

As $pUR_G > (1-p)UR_G$ but As $(1-p)UR_B < pUR_B$ y $-\frac{d_H}{A_{YY}} < -\frac{d_L}{A_{YY}}$ sub scenarios arise:

$$R_G > \frac{\left[(1-p)U_{RG} + pU_{RB} - \left(\frac{d_L}{A_{YY}}\right) - (1-p)U_{RB} + \left(\frac{d_H}{A_{YY}}\right)\right]}{pU}$$

Being

$$\pi_1 = \frac{\left[(1-p)U_{RG} + pU_{RB} - \left(\frac{d_L}{A_{YY}}\right) - (1-p)U_{RB} + \left(\frac{d_H}{A_{YY}}\right)\right]}{pU}$$

If $R_G > \pi_1$ will be chosen (1) with the Strategy P_Y, A_{YY}, W_H

If $R_G < \pi_1$ will be chosen (2) with the Strategy P_Y, A_{YY}, W_L

If $R_G = \pi_1$ you can choose either because both payments are equal.

Now pay 3 (P_Y, A_YN, W_H) is compared with pay 4 (P_Y, A_YN, W_L), corresponding to the decision of an employee with prestige PY who does not make an effort to be accepted AYN, between investing a greater effort WH or less effort WL.

The payment equations:

$$p\left[UR_G - A_{YN} - \frac{d_H}{A_{YN}}\right] + (1-p)\left[UR_B - A_{YN} - \frac{d_H}{A_{YN}}\right]$$

Strategy (P_Y, A_{YN}, W_H) (3)

$$(1-p)\left[UR_G - A_{YN} - \frac{d_L}{A_{YN}}\right] + p\left[UR_B - A_{YN} - \frac{d_L}{A_{YN}}\right]$$

Strategy (P_Y, A_{YN}, W_L) (4)

Simplifying (3) $pUR_G + (1-p)UR_B - A_{YN} - \frac{d_H}{A_{YN}}$

Simplifying (4) $(1-p)UR_G + pUR_B - A_{YN} - \frac{d_L}{A_{YN}}$

As $pUR_G > (1-p)UR_G$ but As $(1-p)UR_B < pUR_B$ y $-\frac{d_H}{A_{YN}} < -\frac{d_L}{A_{YN}}$ subscenarios arise:

$$R_G > \frac{\left[(1-p)U_{RG} + pU_{RB} - \left(\frac{d_L}{A_{YN}}\right) - (1-p)U_{RB} + \left(\frac{d_H}{A_{YN}}\right)\right]}{pU}$$

Being

$$\pi_2 = \frac{\left[(1-p)U_{RG} + pU_{RB} - \left(\frac{d_L}{A_{YN}}\right) - (1-p)U_{RB} + \left(\frac{d_H}{A_{YN}}\right)\right]}{pU}$$

If $R_G > \pi_2$ will be chosen (3) with the Strategy P_Y, A_{YN}, W_H

If $R_G < \pi_2$ will be chosen (4) with the Strategy P_Y, A_{YN}, W_L

If $R_G = \pi_2$ you can choose either because both payments are equal.

Now we analyze the case of an employee without prestige. Pay 5 (PN, ANY, WH) is compared with pay 6 (PN, AYY, WL), corresponding to the decision of an employee without prestige PN who strives to be accepted AYY, between investing a greater effort WH or a less effort WL.

The payment equations:

$$q\left[UR_G - A_{NY} - \frac{d_H}{A_{NY}}\right] + (1-q)\left[UR_B - A_{NY} - \frac{d_H}{A_{NY}}\right]$$

Strategy (P_Y, A_{NY}, W_H) (5)

$$(1-q)\left[UR_G - A_{NY} - \frac{d_L}{A_{NY}}\right] + q[UR_B - A_{NY} - d_L/A_{NY}]$$

Strategy (P_Y, A_{NY}, W_L) (6)

Simplifying (5) $qUR_G + (1-q)UR_B - A_{NY} - \frac{d_H}{A_{NY}}$

Simplifying (6) $(1-q)UR_G + qUR_B - A_{NY} - \frac{d_L}{A_{NY}}$

As $qUR_G > (1-q)UR_G$ but As $(1-q)UR_B < qUR_B$ y $-\frac{d_H}{A_{NY}} < -\frac{d_L}{A_{NY}}$ sub scenarios arise:

$$R_G > \frac{\left[(1-q)U_{RG} + qU_{RB} - \left(\frac{d_L}{A_{NY}}\right) - (1-q)U_{RB} + \left(\frac{d_H}{A_{NY}}\right)\right]}{qU}$$

Being

$$\pi_3 = \frac{\left[(1-q)U_{RG} + qU_{RB} - \left(\frac{d_L}{A_{NY}}\right) - (1-q)U_{RB} + \left(\frac{d_H}{A_{NY}}\right)\right]}{qU}$$

If $R_G > \pi_3$ will be chosen (5) with the Strategy P_N, A_{NY}, W_H

If $R_G < \pi_3$ will be chosen (6) with the Strategy P_N, A_{NY}, W_L

If $R_G = \pi_3$ you can choose either because both payments are equal.

Pay 7 (PN, ANN, WH) is compared with pay 8 (PN, ANN, WL), corresponding to the decision of an employee without prestige PN who does not make an effort to be accepted ANN, between investing a greater effort WH or less effort WL.

The payment equations:

$$q\left[UR_G - A_{NN} - \frac{d_H}{A_{NN}}\right] + (1-q)\left[UR_B - A_{NN} - \frac{d_H}{A_{NN}}\right]$$

Strategy (P_N, A_{NN}, W_H) (7)

$$(1-q)\left[UR_G - A_{NN} - \frac{d_L}{A_{NN}}\right] + q\left[UR_B - A_{NN} - \frac{d_L}{A_{NN}}\right]$$

Strategy (P_N, A_{NN}, W_L) (8)

Simplifying (7) $qUR_G + (1-q)UR_B - A_{NN} - \frac{d_H}{A_{NN}}$

Simplifying (8) $(1-q)UR_G + qUR_B - A_{NN} - \frac{d_L}{A_{NN}}$

As $qUR_G > (1-q)UR_G$ but As $(1-q)UR_B < qUR_B$ y $-\frac{d_H}{A_{NN}} < -\frac{d_L}{A_{NN}}$ sub scenarios arise:

$$R_G > \frac{\left[(1-q)U_{RG} + qU_{RB} - \left(\frac{d_L}{A_{NN}}\right) - (1-q)U_{RB} + \left(\frac{d_H}{A_{NN}}\right)\right]}{qU}$$

Being

$$\pi_4 = \frac{\left[(1-p)U_{RG} + pU_{RB} - \left(\frac{d_L}{A_{NN}}\right) - (1-p)U_{RB} + \left(\frac{d_H}{A_{NN}}\right)\right]}{pU}$$

If $R_G > \pi_4$ will be chosen (7) with the Strategy P_N, A_{NN}, W_H

If $R_G < \pi_4$ will be chosen (8) with the Strategy P_N, A_{NN}, W_L

If $R_G = \pi_4$ you can choose either because both payments are equal.

Now it is analyzed When $R_G > \pi_1, \pi_2, \pi_3, \pi_4$

Payment (1) is compared with payment (3):

$$p\left[UR_G - A_{YY} - \frac{d_H}{A_{YY}}\right] + (1-p)\left[UR_B - A_{YY} - \frac{d_H}{A_{YY}}\right]$$

Strategy (P_Y, A_{YY}, W_H) (1)

$$p\left[UR_G - A_{YN} - \frac{d_H}{A_{YN}}\right] + (1-p)\left[UR_B - A_{YN} - \frac{d_H}{A_{YN}}\right]$$

Strategy (P_Y, A_{YN}, W_H) (3)

Simplifying (1) $pUR_G + (1-p)UR_B - A_{YY} - \frac{d_H}{A_{YY}}$

Simplifying (3) $pUR_G + (1-p)UR_B - A_{YN} - \frac{d_H}{A_{YN}}$

$-A_{YY} - d_H/A_{YY}$ (1)

$-A_{YN} - d_H/A_{YN}$ (3)

As $A_{YY} > A_{YN}$ but $\frac{d_H}{A_{YY}} < \frac{d_H}{A_{YY}}$ Subscenarios arise based on the acceptance factor. Thus, the acceptance factor significantly impacts the effort and therefore the disutility perceived by the employee:

When the acceptance factor is high:

$$A_{YY} > A_{YN} + \left(\frac{d_H}{A_{YN}} - \frac{d_H}{A_{YY}}\right)$$

The impact on disutility is less so it will subtract less from utility and will be chosen (1). When the acceptance factor is low:

$$A_{YY} < A_{YN} + \left(\frac{d_H}{A_{YN}} - \frac{d_H}{A_{YY}}\right)$$

The impact on disutility is greater so it will subtract more from utility and will be chosen (3).

When $A_{YY} = A_{YN} + \left(\frac{d_H}{A_{YN}} - \frac{d_H}{A_{YY}}\right)$ you can choose either of the two payments because they will be worth the same.

To analyze the case of the employee without prestige, the payment (5) is compared with the payment (7):

$$q\left[UR_G - A_{NY} - \frac{d_H}{A_{NY}}\right] + (1-q)\left[UR_B - A_{YY} - \frac{d_H}{A_{NY}}\right]$$

Strategy (P_N, A_{NY}, W_H) (5)

$$q\left[UR_G - A_{NN} - \frac{d_H}{A_{NN}}\right] + (1-q)\left[UR_B - A_{NN} - \frac{d_H}{A_{NN}}\right]$$

Strategy (P_N, A_{NN}, W_H) (7)

Simplifying (5) $qUR_G + (1-q)UR_B - A_{NY} - \frac{d_H}{A_{NY}}$

Simplifying (7) $qUR_G + (1-q)UR_B - A_{NN} - \frac{d_H}{A_{NN}}$

$-A_{NY} - \frac{d_H}{A_{NY}}$ (5)

$-A_{NN} - \frac{d_H}{A_{NN}}$ (7)

As $A_{NY} > A_{NN}$ but $\frac{d_H}{A_{NY}} < \frac{d_H}{A_{NN}}$ Subscenarios arise based on the acceptance factor. Thus the acceptance factor significantly impacts the effort and therefore the disutility perceived by the employee:

When the acceptance factor is high:

$$A_{NY} > A_{NN} + \left(\frac{d_H}{A_{NN}} - \frac{d_H}{A_{NY}}\right)$$

The impact on disutility is less so it will subtract less from the utility and will be chosen

P_N, A_{NY}, W_H (5)

When the acceptance factor is low:

$$A_{NY} < A_{NN} + \left(\frac{d_H}{A_{NN}} - \frac{d_H}{A_{NY}}\right)$$

The impact on disutility is greater so it will subtract more from the utility and will be chosen

P_N, A_{NN}, W_H (7)

When $A_{NY} = A_{NN} + \left(\frac{d_H}{A_{NN}} - \frac{d_H}{A_{NY}}\right)$you can choose either of the two payments because they will be worth the same.

Now it is analyzed When $R_G < \pi_1, \pi_2, \pi_3, \pi_4$

Payment (2) is compared with payment (4):

$(1-p)\left[UR_G - A_{YY} - \frac{d_L}{A_{YY}}\right] + p\left[UR_B - A_{YY} - \frac{d_L}{A_{YY}}\right]$

Strategy (P_Y, A_{YY}, W_L) (2)

$(1-p)\left[UR_G - A_{YN} - \frac{d_L}{A_{YN}}\right] + p\left[UR_B - A_{YN} - \frac{d_L}{A_{YN}}\right]$

Strategy (P_Y, A_{YN}, W_L) (4)

Simplifying (2) $(1-p)UR_G + pUR_B - A_{YY} - \frac{d_L}{A_{YY}}$

Simplifying (4) $(1-p)UR_G + pUR_B - A_{YN} - \frac{d_L}{A_{YN}}$

$-A_{YY} - \frac{d_L}{A_{YY}}$ (2)

$-A_{YN} - \frac{d_L}{A_{YN}}$ (4)

As $A_{YY} > A_{YN}$ but $\frac{d_L}{A_{YY}} < \frac{d_L}{A_{YN}}$ Subscenaries arise based on the acceptance factor. Thus the acceptance factor significantly impacts the effort and therefore the disutility perceived by the employee:

When the acceptance factor is high:

$$A_{YY} > A_{YN} + \left(\frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}\right)$$

The impact on disutility is less so it will subtract less from the utility and will be chosen

P_Y, A_{YY}, W_L (2)

When the acceptance factor is low:

$$A_{YY} < A_{YN} + \left(\frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}\right)$$

The impact on disutility is greater so it will subtract more from the utility and will be chosen

P_Y, A_{YN}, W_L (4)

When$A_{YY} = A_{YN} + \left(\frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}\right)$ you can choose either of the two payments because they will be worth the same.

To analyze the case of the employee without prestige, payment (6) is compared with payment (8):

$(1-q)\left[UR_G - A_{NY} - \frac{d_L}{A_{NY}}\right] + q\left[UR_B - A_{YY} - \frac{d_L}{A_{NY}}\right]$

Strategy (P_N, A_{NY}, W_L) (6)

$(1-q)\left[UR_G - A_{NN} - \frac{d_L}{A_{NN}}\right] + q\left[UR_B - A_{NN} - \frac{d_L}{A_{NN}}\right]$

Strategy (P_N, A_{NN}, W_L) (8)

Simplifying (6) $(1-q)UR_G + qUR_B - A_{NY} - \frac{d_L}{A_{NY}}$

Simplifying (8) $(1-q)UR_G + qUR_B - A_{NN} - \frac{d_L}{A_{NN}}$

$-A_{NY} - \frac{d_L}{A_{NY}}$ (6)

$-A_{NN} - \frac{d_L}{A_{NN}}$ (8)

As $A_{NY} > A_{NN}$ but $\frac{d_L}{A_{NY}} < \frac{d_L}{A_{NN}}$ Subscenaries arise based on the acceptance factor. Thus, the acceptance factor significantly impacts the effort and therefore the disutility perceived by the employee:

When the acceptance factor is high:

$$A_{NY} > A_{NN} + \left(\frac{d_L}{A_{NN}} - \frac{d_L}{A_{NY}}\right)$$

The impact on disutility is less so it will subtract less from the utility and will be chosen

P_N, A_{NY}, W_L (6)

When the acceptance factor is low:

$$A_{NY} < A_{NN} + \left(\frac{d_L}{A_{NN}} - \frac{d_L}{A_{NY}}\right)$$

The impact on disutility is greater so it will subtract more from the utility and will be chosen

P_N, A_{NN}, W_L (8)

When $A_{NY} = A_{NN} + \left(\frac{d_L}{A_{NN}} - \frac{d_L}{A_{NY}}\right)$ you can choose either of the two payments because they will be worth the same.

Now the Director will choose the best payment for him.

(P$_Y$) $p(G - R_G) + (1-p)(B - R_B)$
(P$_N$) $q(G - R_G) + (1-q)(B - R_B)$

Simplifying:

(P$_Y$) $pG - pR_G - pB + pR_B$
(P$_N$) $qG - qR_G - qB + qR_B$

$$G > \frac{[qG - qR_G - qB + qR_B + pR_G + pB - pR_B]}{p}$$

$$\pi_5 = \frac{[qG - qR_G - qB + qR_B + pR_G + pB - pR_B]}{p}$$

Sub-scenarios then arise:

When G > π_5 will be chosen (P$_Y$)

When G < π_5 will be chosen (P$_N$)

When G= π_5 anyone can be chosen since both payments are equal.

In this way,

When G > π_5

If $R_G > \pi_1$ y $A_{YY} > A_{YN} + \frac{d_H}{A_{YN}} - \frac{d_H}{A_{YY}}$, the dominant Strategy will be P_Y, A_{YY}, W_H

ó

If $R_G > \pi_1$ y $A_{YY} < A_{YN} + \frac{d_H}{A_{YN}} - \frac{d_H}{A_{YY}}$, the dominant Strategy will be P_Y, A_{YN}, W_H

ó

If $R_G < \pi_1$ y $A_{YY} > A_{YN} + \frac{d_H}{A_{YN}} - \frac{d_H}{A_{YY}}$, the dominant Strategy will be P_Y, A_{YY}, W_L

ó

If $R_G < \pi_1$ y $A_{YY} < A_{YN} + \frac{d_H}{A_{YN}} - \frac{d_H}{A_{YY}}$, the dominant Strategy will be P_Y, A_{YN}, W_L

When G<π_5

If $R_G > \pi_2$ y $A_{NY} > A_{NN} + \frac{d_H}{A_{NN}} - \frac{d_H}{A_{NY}}$, the dominant Strategy will be P_N, A_{YY}, W_H

ó

If $R_G > \pi_2$ y $A_{NY} < A_{NN} + \frac{d_H}{A_{NN}} - \frac{d_H}{A_{NY}}$, the dominant Strategy will be P_N, A_{YN}, W_H

ó

If $R_G < \pi_2$ y $A_{NY} > A_{NN} + \frac{d_H}{A_{NN}} - \frac{d_H}{A_{NY}}$, the dominant Strategy will be P_N, A_{YY}, W_L

ó

If $R_G < \pi_2$ y $A_{NY} < A_{NN} + \frac{d_H}{A_{NN}} - \frac{d_H}{A_{NY}}$, the dominant Strategy will be P_N, A_{YN}, W_L

Scenario 3 Payment plus incentive (R ') based on the prestige of the employee

In the case of this scenario, the payment is given solely based on the prestige of the employee. Since the manager cannot judge the employee's efforts, he will pay the incentive based on the employee's prestige. For example, the manager pays:

- An RPY incentive When the selected employee has prestige.

- An RPN incentive When the selected employee has no prestige.

Therefore, the net payments to the manager at the two levels are, respectively:

G - R$_{PY}$

G - R$_{PN}$

B – R$_{PY}$

B – R$_{PN}$

From the perspective of earnings from payments, these can be expressed as a function of incentives:

U (R$_{PY}$) for a good profit scenario

U (R$_{PN}$) for a bad profit scenario

However, payments should be tied to perceived dissatisfaction (or disutility) for the level of effort the employee needs to spend (the difficulty) of achieving the incentive. Assuming that disutility As dH When the employee puts in a lot of effort and dL When the employee tries less, the net payments to the employee at the two levels are, respectively:

U (R$_{PY}$) - d$_H$

U (R$_{PN}$) - d$_H$

U (R$_{PY}$) – d$_L$

U (R_{PN}) - d_L

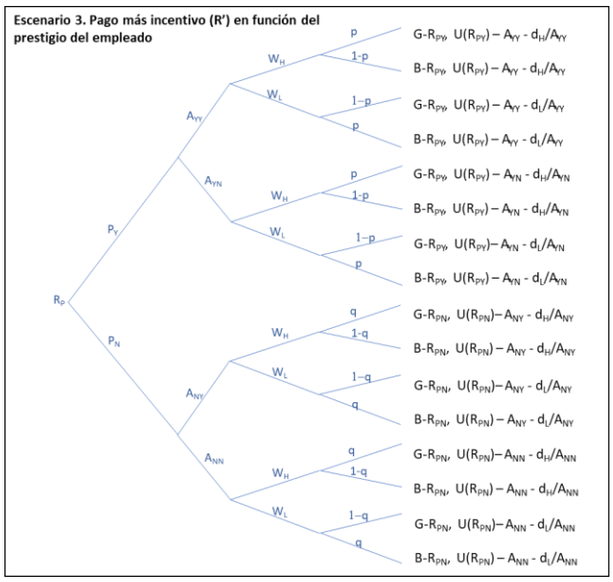

Figure 3 Scenario 3 Payment plus incentive (R ') based on the prestige of the employee
Source: Self-made

For this case, the solution of the best payments for employees is the same as in scenario 1. For the Director, it is compared:

$(P_Y)\quad p(G - R_{PY}) + (1-p)(B - R_{PY})$

$(P_N)\quad q(G - R_{PN}) + (1-q)(B - R_{PN})$

Simplifying:

$(P_Y)\quad pG + (1-p)B - R_{PY}$

$(P_N)\quad qG + (1-q)B - R_{PN}$

$$G > \frac{[qG + (1-q)B - R_{PN} - (1-p)B + R_{PY}]}{p}$$

$$\pi_6 = \frac{[qG + (1-q)B - R_{PN} - (1-p)B + R_{PY}]}{p}$$

Sub-scenarios then arise:

When G > π_6 will be chosen (P_Y)

When G < π_6 will be chosen (P_N)

When G=π_6 anyone can be chosen since both payments are equal.

In this way,

When G > π_6

If $A_{YY} > A_{YN} + \frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}$ the dominant Strategy will be P_Y, A_{YY}, W_L

ó

If $A_{YY} < A_{YN} + \frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}$ the dominant Strategy will be P_Y, A_{YN}, W_L

ó

If $A_{YY} = A_{YN} + \frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}$ you can choose any payment as both payments are equal.

When G < π_6

If $A_{NY} > A_{NN} + \frac{d_L}{A_{NN}} - \frac{d_L}{A_{NY}}$ the dominant Strategy will be P_N, A_{YY}, W_L

ó

If $A_{NY} < A_{NN} + \frac{d_L}{A_{NN}} - \frac{d_L}{A_{NY}}$ the dominant Strategy will be P_N, A_{YN}, W_L

ó

If $A_{NY} = A_{NN} + \frac{d_L}{A_{NN}} - \frac{d_L}{A_{NY}}$ You can choose any PN, AYY, WL or PN, AYN, WL payment since both payments are the same.

When G = π_6 you can choose any payment from W_L (2, 4, 6 u 8).

Scenario 4 Payment plus incentive (R'P) based on the profitability of the project

In the case of this scenario, each employee option has an impact on the profit of the project depending on the profitability of the project and the prestige. Since the manager cannot judge the employee's efforts, he will pay the incentive based on the profitability achieved, so the incentive will be based on whether the project had a good or a bad profit and based on prestige. The higher the prestige, the corresponding prestige pay will be higher. For example, the manager pays:

An RPG Incentive When Earning Level is G and

An RPB Incentive When Profit is B
Therefore, the net payments to the manager at the two levels are, respectively:

G - R_{PG}

B - R_{PB}

From the perspective of earnings from payments, these can be expressed as a function of incentives:

$U(R_{PG})$ for a good profit scenario for an employee with high prestige.

$U(R_G)$ for a good profit scenario for an employee with low prestige.

$U(R_{PB})$ for a low profit scenario for a high prestige employee.

$U(R_B)$ for a low profit scenario for a low prestige employee.

However, payments should be tied to perceived dissatisfaction (or disutility) for the level of effort the employee needs to spend (the difficulty) of achieving the incentive. Assuming that disutility As dH When the employee puts in a great effort and dL When the employee puts in less effort, the net payments for the employee at the two levels are, respectively:

$U(R_{PG}) - d_H$

$U(R_{PG}) - d_L$

$U(R_G) - d_H$

$U(R_G) - d_L$

$U(R_{BG}) - d_H$

$U(R_{BG}) - d_L$

$U(R_B) - d_H$

$U(R_B) - d_L$

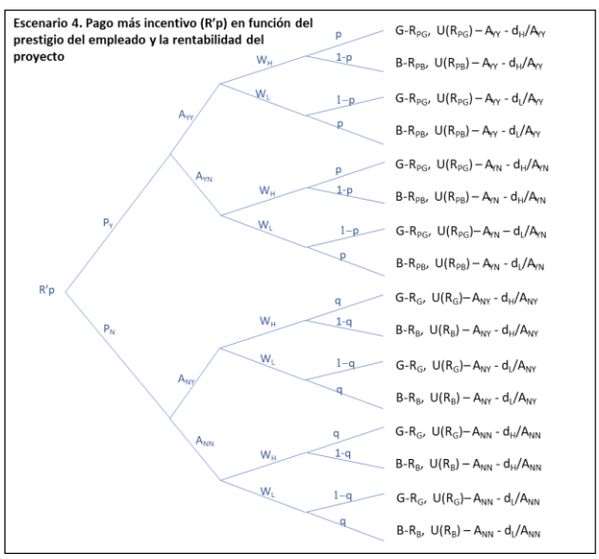

Figure 4 Game tree for Scenario 4 Payment plus incentive based on project profitability and prestige.
Source: Self-made

Scenario Solution 4

To solve this dynamic non-cooperative game with complete information, you start by comparing the corresponding payouts for a prestigious employee.

Payment 1 (P_Y, A_YY, W_H) is compared with payment 2 (P_Y, A_YY, W_L), corresponding to the decision of an employee with prestige P_Y who strives to be accepted A_YY, between investing a greater effort W_H or a least effort W_L.

The payment equations:

$$p\left[UR_{PG} - A_{YY} - \frac{d_H}{A_{YY}}\right] + (1-p)\left[URP_B - A_{YY} - \frac{d_H}{A_{YY}}\right]$$

Strategy $(P_Y, A_{YY,} W_H)(1)$

$$(1-p)\left[UR_{PG} - A_{YY} - \frac{d_L}{A_{YY}}\right] + p\left[UR_{PB} - A_{YY} - \frac{d_L}{A_{YY}}\right]$$

Strategy $(P_Y, A_{YY,} W_L)(2)$

Simplifying (1) $pUR_{PG} + (1-p)UR_{PB} - A_{YY} - \frac{d_H}{A_{YY}}$

Simplifying (2) $(1-p)UR_{PG} + pUR_{PB} - A_{YY} - \frac{d_L}{A_{YY}}$

As $pUR_{PG} > (1-p)UR_{PG}$ but As $(1-p)UR_{PB} < pUR_{PB}$ y $-\frac{d_H}{A_{YY}} < -\frac{d_L}{A_{YY}}$, sub scenarios arise:

$$R_{PG} > \frac{\left[(1-p)UR_{PG} + pUR_{PB} - \left(\frac{d_L}{A_{YY}}\right) - (1-p)UR_{PB} + \left(\frac{d_H}{A_{YY}}\right)\right]}{pU}$$

Being PG

$$\pi_7 = \frac{\left[(1-p)UR_{PG} + pUR_{PB} - \left(\frac{d_L}{A_{YY}}\right) - (1-p)UR_{PB} + \left(\frac{d_H}{A_{YY}}\right)\right]}{pU}$$

If $R_{PG} > \pi_7$ will be chosen (1) with the Strategy P_Y, A_{YY}, W_H

If $R_{PG} < \pi_7$ will be chosen (2) with the Strategy P_Y, A_{YY}, W_L

If $R_{PG} = \pi_7$you can choose either because both payments are equal.

Now payment 3 (P_Y, A_YN, W_H) is compared with payment 4 (P_Y, A_YN, W_L), corresponding to the decision of an employee with prestige PY who does not make an effort to be accepted AYN, between investing a greater effort WH or less effort WL.

The payment equations:

$$p\left[UR_{PG} - A_{YN} - \frac{d_H}{A_{YN}}\right] + (1-p)\left[UR_{PB} - A_{YN} - \frac{d_H}{A_{YN}}\right]$$

Strategy (P_Y, A_{YN}, W_H) (3)

$$(1-p)\left[UR_{PG} - A_{YN} - \frac{d_L}{A_{YN}}\right] + p\left[UR_{PB} - A_{YN} - \frac{d_L}{A_{YN}}\right]$$

Strategy (P_Y, A_{YN}, W_L) (4)

Simplifying (3) $pUR_{PG} + (1-p)UR_{PB} - A_{YN} - \frac{d_H}{A_{YN}}$

Simplifying (4) $(1-p)UR_{PG} + pUR_{PB} - A_{YN} - \frac{d_L}{A_{YN}}$

As $pUR_G > (1-p)UR_G$ but As $(1-p)UR_B < pUR_B$ y $-\frac{d_H}{A_{YN}} < -d_L/A_{YN}$, sub scenarios arise:

$$R_G > \frac{\left[(1-p)UR_{PG} + pUR_{PB} - \left(\frac{d_L}{A_{YN}}\right) - (1-p)UR_{PB} + \left(\frac{d_H}{A_{YN}}\right)\right]}{pU}$$

Being

$$\pi_8 = \frac{\left[(1-p)UR_{PG} + pUR_{PB} - \left(\frac{d_L}{A_{YN}}\right) - (1-p)UR_{PB} + \left(\frac{d_H}{A_{YN}}\right)\right]}{pU}$$

If $R_{PG} > \pi_8$ will be chosen (3) with the Strategy P_Y, A_{YN}, W_H

If $R_{PG} < \pi_8$ will be chosen (4) with the Strategy P_Y, A_{YN}, W_L

If $R_{PG} = \pi_8$ you can choose either because both payments are equal.

Now it is analyzed the case of an employee without prestige. Payment 5 (P_N, A_NY, W_H) is compared with payment 6 (P_N, A_YY, W_L), corresponding to the decision of an employee without prestige PN who strives to be accepted AYY, between investing a greater effort WH or a less effort WL.

The payment equations:

$$q\left[UR_G - A_{NY} - \frac{d_H}{A_{NY}}\right] + (1-q)\left[UR_B - A_{NY} - \frac{d_H}{A_{NY}}\right]$$

Strategy (P_Y, A_{NY}, W_H) (5)

$$(1-q)\left[UR_G - A_{NY} - \frac{d_L}{A_{NY}}\right] + q\left[UR_B - A_{NY} - \frac{d_L}{A_{NY}}\right]$$

Strategy (P_Y, A_{NY}, W_H) (6)

Simplifying (5) $qUR_G + (1-q)UR_B - A_{NY} - \frac{d_H}{A_{NY}}$

Simplifying (6) $(1-q)UR_G + qUR_B - A_{NY} - \frac{d_L}{A_{NY}}$

As $qUR_G > (1-q)UR_G$ but As $(1-q)UR_B < qUR_B$ y $-\frac{d_H}{A_{NY}} < -\frac{d_L}{A_{NY}}$, sub scenarios arise:

$$R_G > \frac{\left[(1-q)UR_G + pUR_B - \left(\frac{d_L}{A_{NY}}\right) - (1-q)U_{RB} + \left(\frac{d_H}{A_{NY}}\right)\right]}{pU}$$

Being

$$\pi_9 = \frac{\left[(1-q)UR_G + pUR_B - \left(\frac{d_L}{A_{NY}}\right) - (1-q)U_{RB} + \left(\frac{d_H}{A_{NY}}\right)\right]}{pU}$$

If $R_G > \pi_9$ will be chosen (5) with the Strategy P_N, A_{NY}, W_H

If $R_G < \pi_9$ will be chosen (6) with the Strategy P_N, A_{NY}, W_L

If $R_G = \pi_9$ you can choose either because both payments are equal.

Payment 7 (P_N, A_ (NN,) W_H) is compared with payment 8 (P_N, A_ (NN,) W_L), corresponding to the decision of an employee without prestige PN who does not make an effort to be accepted ANN, between invest more effort WH or less effort WL.

The payment equations:

$$q\left[UR_G - A_{NN} - \frac{d_H}{A_{NN}}\right] + (1-q)\left[UR_B - A_{NN} - \frac{d_H}{A_{NN}}\right]$$

Strategy (P_N, A_{NN}, W_H) (7)

$$(1-q)\left[UR_G - A_{NN} - \frac{d_L}{A_{NN}}\right] + q\left[UR_B - A_{NN} - \frac{d_L}{A_{NN}}\right]$$

Strategy (P_N, A_{NN}, W_L) (8)

Simplifying (7) $qU_{RG} + (1-q)UR_B - A_{NN} - \frac{d_H}{A_{NN}}$

Simplifying (8) $(1-q)U_{RG} + qUR_B - A_{NN} - \frac{d_L}{A_{NN}}$

As $pUR_G > (1-q)UR_G$ but As $(1-q)UR_B < pUR_B$ y $-\frac{d_H}{A_{NN}} < -\frac{d_L}{A_{NN}}$, sub scenarios arise:

$$R_G > \frac{\left[(1-q)U_{RG} + pU_{RB} - \left(\frac{d_L}{A_{NN}}\right) - (1-q)UR_B + \left(\frac{d_H}{A_{NN}}\right)\right]}{qU}$$

Being

$$\pi_{10} = \frac{\left[(1-q)U_{RG} + pU_{RB} - \left(\frac{d_L}{A_{NN}}\right) - (1-q)UR_B + \left(\frac{d_H}{A_{NN}}\right)\right]}{qU}$$

If $R_G > \pi_{10}$ will be chosen (7) with the Strategy (P_N, A_{NN}, W_H)

If $R_G < \pi_{10}$ will be chosen (8) with the Strategy (P_N, A_{NN}, W_L)

If $R_G = \pi_{10}$ you can choose either because both payments are equal.

Now it is analyzed when $\boldsymbol{R_{PG} > \pi_7, \pi_8, \pi_9, \pi_{10}}$

Payment (1) is compared with payment (3):

$$p\left[UR_{PG} - A_{YY} - \frac{d_H}{A_{YY}}\right] + (1-p)\left[UR_{PB} - A_{YY} - \frac{d_H}{A_{YY}}\right]$$

Strategy P_Y, A_{YY}, W_H (1)

$$p\left[UR_{PG} - A_{YN} - \frac{d_H}{A_{YN}}\right] + (1-p)\left[UR_{PB} - A_{YN} - \frac{d_H}{A_{YN}}\right]$$

Strategy P_Y, A_{YN}, W_H (3)

Simplifying (1)

$$pUR_{PG} + (1-p)UR_{PB} - A_{YY} - \frac{d_H}{A_{YY}}$$

$$-A_{YY} - \frac{d_H}{A_{YY}} \quad (1)$$

$$-A_{YN} - \frac{d_H}{A_{YN}} \quad (3)$$

As $A_{YY} > A_{YN}$ but $\frac{d_H}{A_{YY}} < \frac{d_H}{A_{YN}}$ Subscenarios arise based on the acceptance factor. Thus the acceptance factor significantly impacts the effort and therefore the disutility perceived by the employee:

When the acceptance factor is high:

$$A_{YY} > A_{YN} + \left(\frac{d_H}{A_{YN}} - \frac{d_H}{A_{YY}}\right)$$

The impact on disutility is less so it will subtract less from utility and will be chosen (1). When the acceptance factor is low:

$$A_{YY} < A_{YN} + \left(\frac{d_H}{A_{YN}} - \frac{d_H}{A_{YY}}\right)$$

The impact on disutility is greater so it will subtract more from utility and will be chosen (3).

When $A_{YY} = A_{YN} + \left(\frac{d_H}{A_{YN}} - \frac{d_H}{A_{YY}}\right)$ you can choose either of the two payments because they will be worth the same.

To analyze the case of the employee without prestige, the payment (5) is compared with the payment (7):

$$q\left[UR_G - A_{NY} - \frac{d_H}{A_{NY}}\right] + (1-q)\left[UR_B - A_{YY} - \frac{d_H}{A_{NY}}\right]$$

Strategy (P_N, A_{NY}, W_H) (5)

$$q\left[UR_G - A_{NN} - \frac{d_H}{A_{NN}}\right] + (1-q)\left[UR_B - A_{NN} - \frac{d_H}{A_{NN}}\right]$$

Strategy (P_N, A_{NN}, W_H) (7)

Simplifying (5)

$$qUR_G + (1-q)UR_B - A_{NY} - \frac{d_H}{A_{NY}}$$

Simplifying (7)

$$qUR_G + (1-q)UR_B - A_{NN} - \frac{d_H}{A_{NN}}$$

(5) $-A_{NY} - \frac{d_H}{A_{NY}}$

(7) $-A_{NN} - \frac{d_H}{A_{NN}}$

As $A_{NY} > A_{NN}$ but $\frac{d_H}{A_{NY}} < \frac{d_H}{A_{NN}}$ Subscenarios arise based on the acceptance factor. Thus the acceptance factor significantly impacts the effort and therefore the disutility perceived by the employee:

When the acceptance factor is high:

$$A_{NY} > A_{NN} + \left(\frac{d_H}{A_{NN}} - \frac{d_H}{A_{NY}}\right)$$

The impact on disutility is less so it will subtract less from the utility and will be chosen

$$P_N, A_{NY}, W_H \quad (5)$$

When the acceptance factor is low:

$$A_{NY} < A_{NN} + \left(\frac{d_H}{A_{NN}} - \frac{d_H}{A_{NY}}\right)$$

The impact on disutility is greater so it will subtract more from the utility and will be chosen

$$P_N, A_{NN}, W_H \quad (7)$$

When $A_{NY} = A_{NN} + \left(\frac{d_H}{A_{NN}} - \frac{d_H}{A_{NY}}\right)$ you can choose either of the two payments because they will be worth the same.

Now it is analyzed When $\boldsymbol{R_G} < \boldsymbol{\pi_1, \pi_2, \pi_3, \pi_4}$

Payment (2) is compared with payment (4):

$$(1-p)\left[UR_{PG} - A_{YY} - \frac{d_L}{A_{YY}}\right] + p\left[UR_{PB} - A_{YY} - \frac{d_L}{A_{YY}}\right]$$

Strategy $\left(P_Y, A_{YY,} W_L\right)$ (2)

$$(1-p)\left[UR_{PG} - A_{YN} - \frac{d_L}{A_{YN}}\right] + p\left[UR_{PB} - A_{YN} - \frac{d_L}{A_{YN}}\right]$$

Strategy (P_Y, A_{YN}, W_L) (4)

Simplifying (2) $(1-p)UR_{PG} + pU_{RB} - A_{YY} - \frac{d_L}{A_{YY}}$

Simplifying (4) $(1-p)UR_{PG} + pU_{RB} - A_{YN} - \frac{d_L}{A_{YN}}$

$$-A_{YY} - \frac{d_L}{A_{YY}} \quad (2)$$

$$-A_{YN} - \frac{d_L}{A_{YN}} \quad (4)$$

As $A_{YY} > A_{YN}$ but $\frac{d_L}{A_{YY}} < \frac{d_L}{A_{YN}}$ Subscenarios arise based on the acceptance factor. Thus, the acceptance factor significantly impacts the effort and therefore the disutility perceived by the employee:

When the acceptance factor is high:

$$A_{YY} > A_{YN} + \left(\frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}\right)$$

The impact on disutility is less so it will subtract less from the utility and will be chosen

$$P_Y, A_{YY}, W_L \quad (2)$$

When the acceptance factor is low:

$$A_{YY} < A_{YN} + \left(\frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}\right)$$

The impact on disutility is greater so it will subtract more from the utility and will be chosen

$$P_Y, A_{YN}, W_L \quad (4)$$

When $A_{YY} = A_{YN} + \left(\frac{d_L}{A_{YN}} - \frac{d_L}{A_{YY}}\right)$ you can choose either of the two payments because they will be worth the same.

To analyze the case of the employee without prestige, payment (6) is compared with payment (8):

$$(1-q)\left[UR_G - A_{NY} - \frac{d_L}{A_{NY}}\right] + q\left[UR_B - A_{YY} - \frac{d_L}{A_{NY}}\right]$$

Strategy (P_N, A_{NY}, W_L) (6)

$$(1-q)\left[UR_G - A_{NN} - \frac{d_L}{A_{NN}}\right] + q\left[UR_B - A_{NN} - \frac{d_L}{A_{NN}}\right]$$

Strategy (P_N, A_{NN}, W_L) (8)

Simplifying (6) $(1-q)UR_G + qUR_B - A_{NY} - \frac{d_L}{A_{NY}}$

Simplifying (8) $(1-q)UR_G + qUR_B - A_{NN} - \frac{d_L}{A_{NN}}$

(6) $-A_{NY} - \frac{d_L}{A_{NY}}$

(8) $-A_{NN} - \frac{d_L}{A_{NN}}$

As $A_{NY} > A_{NN}$ but $\frac{d_L}{A_{NY}} < \frac{d_L}{A_{NN}}$ Sub-sceneries arise based on the acceptance factor. Thus, the acceptance factor significantly impacts the effort and therefore the disutility perceived by the employee:

When the acceptance factor is high:

$$A_{NY} > A_{NN} + \left(\frac{d_L}{A_{NN}} - \frac{d_L}{A_{NY}}\right)$$

The impact on disutility is less so it will subtract less from the utility and will be chosen

$$(P_N, A_{NY}, W_L) \quad (6)$$

When the acceptance factor is low:

$$A_{NY} < A_{NN} + \left(\frac{d_L}{A_{NN}} - \frac{d_L}{A_{NY}}\right)$$

The impact on disutility is greater so it will subtract more from the utility and will be chosen

$$(P_N, A_{NY}, W_L) \quad (8)$$

When $A_{NY} = A_{NN} + \left(\frac{d_L}{A_{NN}} - \frac{d_L}{A_{NY}}\right)$you can choose either of the two payments because they will be worth the same.

Now the Director will choose the best payment for him.

(P$_Y$) $p(G - R_{PG}) + (1-p)(B - R_{PB})$

(P$_N$) $q(G - R_G) + (1-q)(B - R_B)$

Simplifying:

(P$_Y$) $pG - pR_{PG} - R_{PB} - pB + pR_{PB}$

(P$_N$) $qG - qR_G - R_B - qB + qR_B$

$$G > \frac{[qG - qR_G - R_B - qB + qR_B + pR_{PG} + R_{PB} + pB - pR_{PB}]}{p}$$

$$\pi_{11} = \frac{[qG - qR_G - R_B - qB + qR_B + pR_{PG} + R_{PB} + pB - pR_{PB}]}{p}$$

Sub-scenarios then arise:

When $G > \pi_{11}$ will be chosen (P$_Y$)

When $G < \pi_{11}$ will be chosen (P$_N$)

When $G = \pi_{11}$ anyone can be chosen since both payments are equal.

In this way,

When $G > \pi_{11}$

If $R_{PG} > \pi_7$ y $A_{YY} > A_{YN} + \frac{d_H}{A_{YN}} - \frac{d_H}{A_{YY}}$, the dominant Strategy will be (P_Y, A_{YY}, W_H)

ó

If $R_{PG} > \pi_7$ y $A_{YY} < A_{YN} + \frac{d_H}{A_{YN}} - \frac{d_H}{A_{YY}}$, the dominant Strategy will be (P_Y, A_{YN}, W_H)

ó

If $R_{PG} < \pi_7$ y $A_{YY} > A_{YN} + \frac{d_H}{A_{YN}} - \frac{d_H}{A_{YY}}$, the dominant Strategy will be (P_Y, A_{YY}, W_L)

ó

If $R_{PG} < \pi_7$ y $A_{YY} < A_{YN} + \frac{d_H}{A_{YN}} - \frac{d_H}{A_{YY}}$, the dominant Strategy will be (P_Y, A_{YN}, W_L)

ó

When $G < \pi_{11}$

If $R_{PG} > \pi_8$ y $A_{NY} > A_{NN} + \frac{d_H}{A_{NN}} - \frac{d_H}{A_{NY}}$, the dominant Strategy will be (P_N, A_{NY}, W_H)

ó

If If $R_{PG} > \pi_8$ y $A_{NY} < A_{NN} + \frac{d_H}{A_{NN}} - \frac{d_H}{A_{NY}}$, the dominant Strategy will be (P_N, A_{NN}, W_H)

ó

If $R_{PG} < \pi_8$ y $A_{NY} > A_{NN} + \frac{d_H}{A_{NN}} - \frac{d_H}{A_{NY}}$, the dominant Strategy will be (P_N, A_{NY}, W_L)

ó

If $R_{PG} < \pi_8$ y $A_{NY} < A_{NN} + \frac{d_H}{A_{YN}} - \frac{d_H}{A_{NY}}$, the dominant Strategy will be (P_N, A_{NN}, W_L)

ó

When $G = \pi_{11}$ Any option may be chosen based on the employee's conditions previously presented.

Results

As can be seen in the scenarios presented, the rational decisions of employees and employers in situations of knowledge friction can be represented by non-cooperative dynamic games with Principal-Agent situations.

These games can be played considering conditions of prestige and not prestige of the employee, decisions of effort by acceptance or rejection and decisions to make a greater or lesser effort. The variables included are variables supported by the Theory of Knowledge Management and Organizational Culture, as well as the observation of cases through ten years in an Institution. The risk of scenarios that are affected by external factors, represented by the probabilities of generating good or bad projects, makes evident the need to continue adjusting the modeling to reality. Managers, based on the expected profit from the project, must decide if to pay more in order to increase the chances of success of major projects. In Institutions where employee prestige is an important factor for employees, and there are significant differences in their perception of who, as the project leader, shares the information, a scenario with a fixed incentive does not motivate to make an effort for acceptance or for the realization of the project, since the result does not matter, considering a fixed payment. However, when the profit difference between a good project and a bad project is very low and the chances of the project going well for various reasons is high, scenario 1 might be the most suitable for those involved in the game. Scenario 2 is a scenario that presents a more favorable incentive in situations where there are no significant differences in the level of prestige, and there are significant differences in the profitability of the projects, clearly distinguishing between a project that goes well and one that goes bad. When the probability of success increases significantly due to the effort made, it is more advisable to choose an incentive that motivates you to carry out a good project together with a higher payment. In scenario 2, the Director would consider the importance of a higher profit and the greater probability of success that a prestigious employee gives him, so he would choose a prestigious employee over a non-prestigious employee When the rest of the conditions are equal. Scenario 3 shows a similar scenario to scenario 1 and As the payment is not linked to profitability, as long as the probabilities of success are similar, the employee will always choose the minimum effort. When the chances of success are higher and exceed the pay difference of a prestigious employee, the Director will choose an employee without prestige because the payment received by the Director will be higher.

Scenario 4 shows a more adjustable approach to situations where the profit difference between good projects and bad projects is significant and there are more variables that can reinforce the probability of success through more attractive incentives depending on the employee's conditions, such As the prestige that the experience of successful projects gives, the effort to be accepted and the effort in carrying out the project.

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Conclusions

When projects do not make a profit difference for a good or bad project, Directors will choose to pay fixed incentives. What happens in scenarios like these, on the employee's side, is that the tragedy of the public good can occur. Scenario 1 shows an example of this When there is an equal probability of obtaining a good or a bad project, since the employee will always choose the minimum effort for the same payment. The same occurs with scenario 3, when the incentive is not linked to the win, with the difference that, in repetitive games, the circumstances could change including the variable of increasing or decreasing prestige for the following games that could impact the expected future profit, but further analysis is required. Incentives based on results are much more recommendable When the difference in profits between a good and a bad project is significant since the utility of both parties will exceed the perceived disutilities and then the effort will be perceived as more rewarding.

It is difficult for organizations to monitor and control the application of tacit knowledge by their employees. Analysis of the game model suggests that moral hazard compounds the problem and requires additional initiatives. To combat these types of events, it is necessary to change employee behaviors so that they are incentivized to put more effort into knowledge initiatives.

Incentives help reinforce positive behaviors and culture (Wong, 2005). Extrinsic reward schemes, as well as economic ones, can decrease intrinsic motivation (As the recognition of their peers) (Frey and Jegen, 2001), so it is recommended to favor associations and contributions that are expected by employees to favor better behaviors in knowledge sharing.

Coinciding with Zhang et al. (2012) favoring and disseminating the performance of highly visible tasks among employees impacts on a behavior that contributes to employee knowledge. For this reason, it is recommended that organizations design balanced incentive mechanisms, incorporating both extrinsic and intrinsic incentives.

It is recommended, according to Yang and Wu (2008), the design of incentives that rewards each action of knowledge contribution, since it is more effective than periodic performance reviews to motivate knowledge behaviors.

By embedding informal mentoring and coaching into employee behavior routines, an institutional "gift culture" can be fostered, promoting collaboration (Gratton & Erickson, 2007). Informal networks within the organization such As communities of practice can promote the exchange of tacit knowledge and collaboration in knowledge sharing and reinforce the prestige status of participating employees and could decrease the effort related to convincing other employees that the knowledge that you want to share is accepted.

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