Game Theory for Project Managers: How AI Helps — and Where it Simply Cannot [1]

Richard Maltzman and Luigi Morsa

ABSTRACT

In VUCA environments, traditional process-based project management is no longer sufficient; instead, project leaders must understand and actively deal with interdependent behaviors of humans and now, of AI-based systems. Through two realistic examples—supplier negotiations and internal competition over scarce resources—the article illustrates how suboptimal Nash equilibria naturally emerge and how project leaders can “change the game” by reshaping incentives, reducing the cost of cooperation, or increasing the cost of conflict. The discussion then explores the growing role of AI-assisted analysis, showing how modern systems can generate payoff matrices, identify equilibria, and visualize strategic structures using tools such as Game Theory Analyzer. However, the article emphasizes that AI cannot replace human leadership: negotiation, trust-building, emotional intelligence, and alignment of interests remain uniquely human capabilities. Ultimately, effective project leadership requires integrating analytical tools, AI insights, and human relational skills to foster cooperation, prevent escalation, and deliver value in complex strategic environments.

Keywords: *Project leadership, VUCA environment, Nash equilibrium, Stakeholder incentives, AI-assisted analysis, Negotiation dynamics, Strategic decision-making, Cooperation vs competition*

1. Introduction: Why Game Theory — and Why Now

Projects are not merely technical undertakings — they are strategic arenas where multiple players, each with their own incentives, constraints, and expectations, interact in ways that shape outcomes - and the delivery of value - far more than any plan or schedule. This is precisely why game theory, the mathematical study of strategic decision-making, offers such a powerful lens for project managers. It helps explain why stakeholders behave the way they do, why cooperation often fails to emerge spontaneously (even though it would benefit all involved), and why delays or conflicts can arise even when everyone appears to be acting rationally.

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The vast majority of project managers do not regularly use game theory in their daily practice. Yet, as the Authors emphasized in a previous article [1], today project managers operate in a highly complex work environment shaped by the well-known (and accelerating) VUCA conditions (Volatility, Uncertainty, Complexity, and Ambiguity, [2]). In such contexts, success cannot come from relying solely on traditional project-management process groups such as controlling, monitoring, and scheduling. These remain necessary, but they are no longer sufficient.

Thriving in VUCA environments requires something more: the ability to understand, interpret, and actively manage the strategic relationships among stakeholders. This is precisely where game theory becomes an invaluable tool. It helps reveal incentives, anticipate reactions, and *understand how each actor's choices influence the others*. For this reason, it should be used — not as a mathematical curiosity, but as a practical instrument for *leading* complex projects – and we use the word *leading* quite intentionally From this point forward, therefore, we will prefer the term project leader rather than project manager. The shift is purposeful: it highlights the importance of leadership in guiding people, reading the strategic landscape, and defining the direction the entire team must follow. From now on, even when we (out of habit) use the term project manager, please read it as project leader.

Adding even more VUCA to a VUCA-infused playing field, artificial intelligence (AI) has reached a level of maturity that allows it to support project leaders with this kind of strategic analysis. Modern AI systems can generate payoff matrices, identify equilibrium conditions, analyze incentives, and simulate how changes in resources or responsibilities might shift stakeholder behavior. In this sense, AI becomes an amplifier of insight: a tool that helps project managers reveal hidden structures, detect patterns, and to better understand the strategic landscape in which they operate.

Yet, as this article argues, AI cannot replace the human project leader. It can map incentives, but it cannot negotiate. It can analyze behavior, but it cannot build trust. It can highlight misalignments, but it cannot realign people. It lacks the direct human experience with specific players' behavior and even the drivers behind these behaviors. The emotional, political, and relational dimensions of cooperation remain fundamentally human.

This article explores how game theory applies to project leadership, how AI can support this analysis, and where the limits of AI end and the irreplaceable role of the project manager begins. Through concrete examples — from supplier negotiations to internal resource conflicts — we show how incentives shape behavior, how equilibria emerge, and how a project manager can "change the game" by reshaping the payoff structure. Finally, we examine how AI-assisted tools such as Game Theory Analyzer can help visualize these dynamics, while emphasizing that only human leadership can transform insight into cooperation.

2. Game Theory in Project Leadership

Game theory applies to project management because projects are systems of interdependent actors (players, if you will) —clients, contractors, subcontractors, suppliers, and internal teams—whose decisions affect one another. Also, in projects, these actors are not part of a permanent structure – they are assembled for the distinct purpose of accomplishing project success, as opposed to overseeing an ongoing operation. This creates exactly the kind of strategic interaction that game theory is designed to analyze [3].

Projects involve multiple stakeholders with different incentives, incomplete information, potentially 'noisy' or even non-existent communications networks, and the ability to influence outcomes negatively or positively. Game theoretic models help explain and predict how these actors behave when their choices are interlinked. Examples include:

- contractor–subcontractor negotiations
- bidding and procurement
- resource allocation conflicts
- risk-sharing decisions
- coordination under uncertainty
- consideration of sustainability in project and product decisions

Incorporating game theory into project management offers a rigorous framework for understanding the complexities of human behavior, competition, and collaboration. It enables project managers to [4]:

- predict stakeholder (player) behavior
- make informed decisions under uncertainty
- negotiate more effectively
- design incentives that align team interests
- allocate resources more efficiently
- manage conflicts in a constructive way

By applying game theoretic models, project managers can navigate the multifaceted challenges that characterize large, complex projects with diverse stakeholders.

3. Game theory in practice for project management

In this section, two realistic examples for project managers/leaders are discussed.

3.1 Project Leader–Supplier Interaction

In many projects, especially when external suppliers are involved, delays and cost overruns do not arise from incompetence or bad faith. They emerge from something far more subtle: misaligned incentives. Game theory offers a simple way to visualize – and potentially repair -this misalignment through a 2×2 payoff matrix, where each cell represents the outcome of a strategic interaction between the Project Leader and the Supplier. An example could be the following one:

Table 1: Payoff Matrix for the Project Leader–Supplier Interaction

	Supplier S_1 (struggles to Deliver on time)	**Supplier S_2 (allows themselves to Deliver late)**
PL P_1 (Absorb the delay of delivery)	*(+5,-5)* • *The PL accepts a slight delay* • *The Supplier still delivers on time but incurs moderate extra cost*	*(-10,+10)* • *The PL suffers a severe delay;* • *The Supplier achieves the maximum benefit (no extra cost);*
PL P_2 (Push hard to have delivery on time)	*(+10,-10)* • *The PL achieves the ideal outcome;* • *The Supplier is forced into heavy overtime, subcontracting, and accelerated logistics.*	*(-5,-5)* • *Conflict escalates: Both act aggressively, but the delivery is still late.* • *The PL faces a moderate delay;* • *The Supplier takes on some extra cost from failed recovery attempts.*

The following conceptual graph also helps clarify, from a project-management perspective, the potential outcomes of undertaking a given strategy.

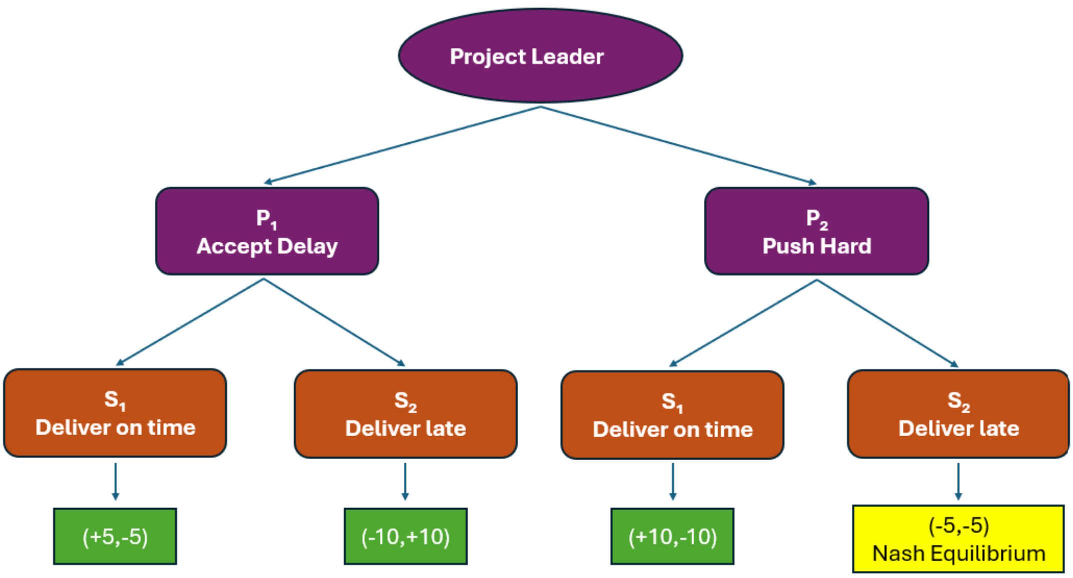

Figure 1: Conceptual graph for the Project Leader–Supplier Interaction

In the basic version of the model, the Project Manager can either accept delay or push for on-time delivery. The supplier, in turn, can either deliver on time—which usually requires overtime, extra staff, or subcontracting—or deliver late, which minimizes their internal costs. When we map these choices into a payoff matrix, something interesting happens: the "natural" equilibrium of the game is not the cooperative one. Both players, acting rationally and independently, tend to converge toward the combination where the Project Manager pushes and the supplier still delivers late:

(P_2, S_2) = (−5, −5) → Both act aggressively, but the delivery is still late.

- PM: moderate delay
- Supplier: some extra cost from failed recovery attempts

This outcome is basically the Nash equilibrium. The Project Manager pushes for on-time delivery and the supplier still delivers late. It is an equilibrium because neither player can improve their payoff by changing strategy alone [5]. Given the supplier chooses late delivery, the Project Manager's best option is to push rather than accept delay. And given the Project Manager pushes, the supplier's best option is still to deliver late, since it avoids the high cost of on-time delivery. Because both players are already doing the best they can given the other's choice, the outcome is stable—even if it is not optimal for either side. This is the essence of a Nash equilibrium: a situation that persists not because it is good, but because no one can improve their position alone.

A Project Manager cannot rewrite the supplier's internal cost structure, but can change the supplier's incentives. And when incentives change, the payoff matrix *itself* changes, which can eliminate the bad Nash equilibrium (P_2, S_2). The PM can change the supplier's incentives through negotiation, contract design, or operational support. This means the PM can:

- **Reduce the supplier's cost of delivering on time**
  (e.g., sharing resources, providing forecasts, smoothing approvals)
- **Increase the supplier's cost of delivering late**
  (e.g., penalties, reputational consequences, priority loss)
- **Increase the supplier's benefit of delivering on time**
  (e.g., bonuses, future contracts, preferred-supplier status)
- **Reduce the PM's own cost of accepting delay**
  (e.g., internal buffers, parallel tasks)

All these actions modify the payoff matrix. In this way the PM can reshape the payoff matrix so that the supplier's best response is no longer S_2.

3.2 Critical Resource shared between 2 Teams

Conflicts in projects do not arise only with external suppliers. They often emerge within the organization itself, especially when two teams depend on the same scarce resource. Game theory again provides a useful lens to understand this dynamic.

Imagine two teams, Team A and Team B, both under schedule pressure and both needing exclusive access to a critical resource. Each team can either cooperate by agreeing to share the resource according to a coordinated plan, or compete by insisting on exclusive access. The situation can be represented by a simple 2×2 payoff matrix:

Table 2: Payoff Matrix for the 2 teams competing over a shared Critical Resource

	Team B: Cooperate	**Team B: Compete**
Team A: Cooperate	*(+5, +5)* Mutual cooperation leads to balanced access to the resource and moderate gains for both teams.	*(−10, +10)* Team A is willing to cooperate Team B takes advantage of the situation, and Team A effectively loses access to the resource.
Team A: Compete	*(+10, −10)* Team A takes advantage of fact that Team B is willing to cooperate. Team B effectively loses access to the resource.	*(−5, −5)* Both escalate the conflict; neither gains reliable access, resulting in delays and extra cost for both.

In the cooperative–cooperative cell, both teams share the resource efficiently and both benefit moderately. But if one team cooperates while the other competes, the competing team gains a clear advantage—exclusive access and schedule protection—while the cooperating team suffers significant delay. And when both teams compete, the result is predictable: conflict, escalation, and inefficient use of the resource, leading to a moderate loss for both.

The “natural” equilibrium of the game is not the cooperative one. Both teams, acting rationally and independently, tend to converge toward the defensive strategy of competing for exclusive access:

(Compete, Compete) = (−5, −5) → Both teams protect themselves, but the resource is used inefficiently and both schedules suffer.

This outcome is another ‘bad’ Nash equilibrium: neither team can improve its situation by changing strategy alone. If Team A expects Team B to compete, cooperating would only worsen its position. And if Team B expects Team A to compete, the same logic applies. The result is stable, but suboptimal for the organization.

Here again, (and this is key) the Project Manager's role is to change the game, not just mediate the conflict. The PM cannot magically increase the availability of the resource, but can reshape the incentives so that cooperation becomes the rational choice for both teams. This can be done by:

- **Introducing transparent allocation rules** (e.g., time-boxed slots, rotating priority, predefined access windows)
- **Clarifying project priorities** (e.g., which deliverables are critical for the overall program)
- **Creating shared performance metrics** (e.g., rewarding teams for system-level outcomes rather than local optimization)
- **Escalating the cost of conflict** (e.g., requiring justification for exclusive access, involving governance boards)

Each of these actions modifies the payoff matrix. Competing becomes less attractive because it no longer guarantees an advantage, while cooperating becomes more rewarding because it leads to predictable access and fewer delays. In this way, the PM can shift the equilibrium from the defensive (Compete, Compete) outcome to a more collaborative and efficient one.

4. AI in Game theory

Any commercial AI chat system today, properly prompted with the context and clear requests [6], is fully capable of generating the payoff matrix, explaining the possible strategies in detail, calculating the Nash equilibrium, and even suggesting how to proceed and which strategies to adopt.

Nowadays, there is no truly mature market for "AI + Game Theory" software. However, platforms like Game Theory Analyzer represent one of the very first concrete attempts to create a dedicated environment. Game Theory Analyzer is a desktop application for AI-assisted game-theoretic analysis of real-world events. As reported on its website [7], helps you model real world strategic interactions — negotiations, competitions, policy decisions — using formal game theory frameworks. You chat with AI about a situation, and the system runs structured multi phase analysis that produces game structures, payoff estimates, and equilibrium results when the methodology reaches formal modeling. Furthermore, all analysis is visualized as an entity graph on a canvas.

Although it is a desktop application, it is built on open source components and can be extended by users who wish to modify or expand its underlying logic. At the same time, it can also be used "as is," provided the user has the basic technical environment required to run the software, namely the ability to run Python code.

You give the system the problem → it passes it to the AI → the AI generates payoffs, strategies, and equilibria → the software visualizes them.

A strategic graph is particularly valuable in project management because it makes visible:

- who makes which decisions
- in what order
- which alternatives are available
- how each choice affects the others

It provides exactly the kind of clarity a project manager needs when defining a strategy for a negotiation, anticipating issues, and preventing escalation.

5. Negotiation: The Human Skill AI Cannot Replace – or - Where AI Stops — and Where Project Leadership Begins

Negotiation is where the project leader becomes irreplaceable. While AI can analyze data, it cannot navigate the emotional, political, and relational dimensions that shape real cooperation. The role of the project manager is to make stakeholders aware that competing becomes less attractive or convenient because it no longer guarantees an advantage, while cooperating becomes more rewarding. In this way, the PM can shift the equilibrium from the defensive (Compete, Compete) outcome to a more collaborative and efficient one. A project leader must:

- read the room
- understand unspoken fears
- manage power dynamics
- build alliances
- mediate conflicts
- create trust
- adjust perceived risks and benefits

These actions directly modify the payoff map in the minds of stakeholders. And this is something no algorithm can do. AI can support the process, but it cannot replace the human ability to influence, persuade, and align people.

Cooperation is human. AI can support it, but only a project leader can create it. We might also say that in a world dominated by algorithms, cooperation remains a uniquely human prerogative.

6. Conclusions — Final Advice

Game theory offers project managers a powerful lens to understand why people behave the way they do in complex projects. Stakeholders do not always act according to what is best for the project; they act according to their own incentives, constraints, fears, and expectations. John Nash's work teaches us that cooperation does not emerge spontaneously.

The two didactic—but plausible—examples presented in this article have shown how a project leader can act to guide a scenario toward a more logical and mutually beneficial cooperative situation. Of course, reality is often more complex than what can be illustrated in an example. In this regard, artificial intelligence can be extremely valuable in analyzing scenarios, identifying patterns, and offering suggestions on how to approach a situation. However, even when AI provides insights or recommendations, the execution—the real negotiation, the alignment of incentives, the creation of cooperation—must always be carried out by the human project leader (we are here very intentional about the use of the word leader). This is where the human dimension of project management remains irreplaceable.

Finally, to truly serve as project leader, it is essential to use all available tools to understand situations as clearly as possible, and to interact extensively with all stakeholders in order to correctly interpret their different positions and the reasoning behind them. Only then can you identify an appropriate strategy for negotiation and mediation. This does not depend solely on innate talent: it requires humility—not presumption—to keep learning every day, to learn from experience, from more seasoned colleagues, to read, to stay informed, to be connected to your team and engaged with other stakeholders, and to strive to improve through careful, self critical reflection.

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About the Authors

Richard Maltzman

Boston, MA, USA

Richard Maltzman considers himself a 'pracademic' – currently (and for the past 10 years or so) Master Lecturer at Boston University, an author, and a consultant, providing clients with deep learning experiences and improved results. Richard "retired" from a 40-year career in telecom, mainly in engineering and project management. At the University level, and in consulting, his focus is always on converting weaknesses into strengths while teaching clients/students how to apply learned skills to everyday situations. In 2010, he co-founded EarthPM, LLC, a company devoted to integrating sustainability thinking into project management. His integration of a holistic, global view of project management has resulted in international consulting and worldwide speaking engagements (Costa Rica, South Africa, Malaysia, China, Mexico, Canada, India, Italy, The Netherlands) in which the focus is the long-term success of projects, with an eye towards ecological and social systems. His blog at PMI's projectmanagement.com (People, Planet, Profits, and Projects) site has become very popular, and he has also started a podcast, "B'yond PM" on Spotify.

Rich is a co-author of seven books on project leadership, including the recent *Great Meetings Build Great Teams*, and the upcoming *Green PMO*, He is a former VP of Professional Development for PMI Mass Bay (the Boston area PMI Chapter), and was on the Review Committee for the 7th Edition PMBOK® Guide, helping to assure that sustainability thinking finally made it into the Standard and the Body of Knowledge. Rich has presented on Sustainability, Project Meetings, Change Management, and PM Competency in Italy, Malaysia, Canada, South Africa, Costa Rica, China, recently keynoting at the PMI Summit Bulgaria in Sofia. Published Works (co-authored): *Green Project Management* (2011 – Winner of PMI's Cleland Award for Literature). *Project Workflow Management: A Business Process Approach* (2014), *Driving Project, Program, and Portfolio Success: The Sustainability Wheel* (2015), *Bridging the PM Competency Gap* (2017), *How to Facilitate Productive Project Planning Meetings*, with Jim Stewart (2018), *Great Meetings Build Great Teams*, with Jim Stewart (2023).

In 2025, Rich published two co-authored works, *AI Powered Leadership*, with Vijay Kanabar, Dave Silberman, and Loredana Abramo, and a Kindle workbook called *Planning Your Project: A Hands-On Guide to AI Integration*, with Vijay Kanabar and Keyur Hindocha. Richard can be contacted at exclaim@bu.edu, https://about.me/richmaltzman and LinkedIn_RM.

Luigi Morsa

Munich Area, Germany

Luigi Morsa is a Team Leader, Project Manager, and Aerospace Engineer who has been working in the aircraft industry in Germany since 2012. He holds a Ph.D. in Space Fluid Dynamics from the University of Naples and was a Visiting Ph.D. student at the University of Michigan (2011). Over the course of his career, he has gained substantial experience in leading teams within highly challenging and demanding environments. His passion for project management has led him to contribute chapters and case studies to several books by Dr. Harold Kerzner, the globally recognized pioneer in the field. These include *Project Management Case Studies* (Wiley, 2017, 2022), Innovation Project Management (Wiley, 2019, 2023), and *Global Project Management* (Wiley, 2026).

Together with Richard Maltzman, PMP and Master Lecturer at Boston University Metropolitan College, Luigi co-authored the chapter 10 Lessons Learnt from Irresponsibility in Project Management for the *De Gruyter Handbook of Responsible Project Management* (De Gruyter, 2023). In April and June 2023, Luigi delivered online lectures on the “Boeing 737-Max Case Study” for the courses Portfolio and Program Management and Project Value Strategies at Boston University. In 2018, Luigi was a speaker at the Project Management Institute EMEA Congress in Berlin, where he discussed the complexity of the aircraft industry market, with particular emphasis on aligning product development with customer needs. He also presented at the 18th Annual Project Management in Practice Conference in Boston (2024), showcasing the latest advancements in artificial intelligence software for project and innovation management.

In November 2024, he spoke alongside Richard Maltzman at the International Project Management Day hosted by International Institute for Learning (IIL), delivering a talk titled Human-AI Synergy in Practice: From Traditional to Innovation Project Management.

Since 2019, Luigi has been a regular contributor to the IIL Blog, publishing articles on topics such as employee engagement, innovation, team management, risk management, conflict resolution, Agile methodologies, and artificial intelligence. Luigi can be contacted at luigi.morsa@outlook.de and LinkedIn_LM.