



Office of
General Services

GOVBUY PROCUREMENT CONFERENCE

November 21-22, 2024

Empire State Plaza Convention Center, Albany, NY



NEW
YORK
STATE

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How to use game theory to maximize your negotiation outcomes

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ZOE PANGALOS
New York

NERA Economic Consulting

Philips Negotiation Center of Excellence

MSc in **Economics** with focus on **Game Theory and Behavioral Economics**

Pricing Strategy Consulting @ PwC

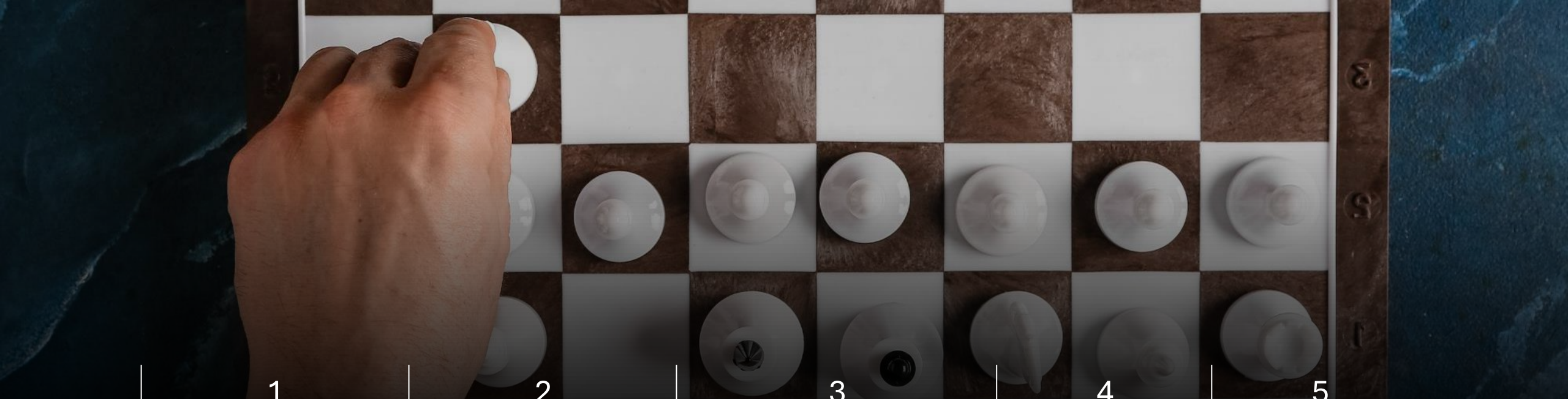
- Extensive experience in negotiation strategy and tactics across a wide range of direct and indirect procurement categories
- Advised on procurement negotiations for companies and governmental bodies throughout the Americas, Europe, and Asia-Pacific.
- Designed and delivered global negotiation trainings in game theory, auction design, and behavioral economics and their application in procurement



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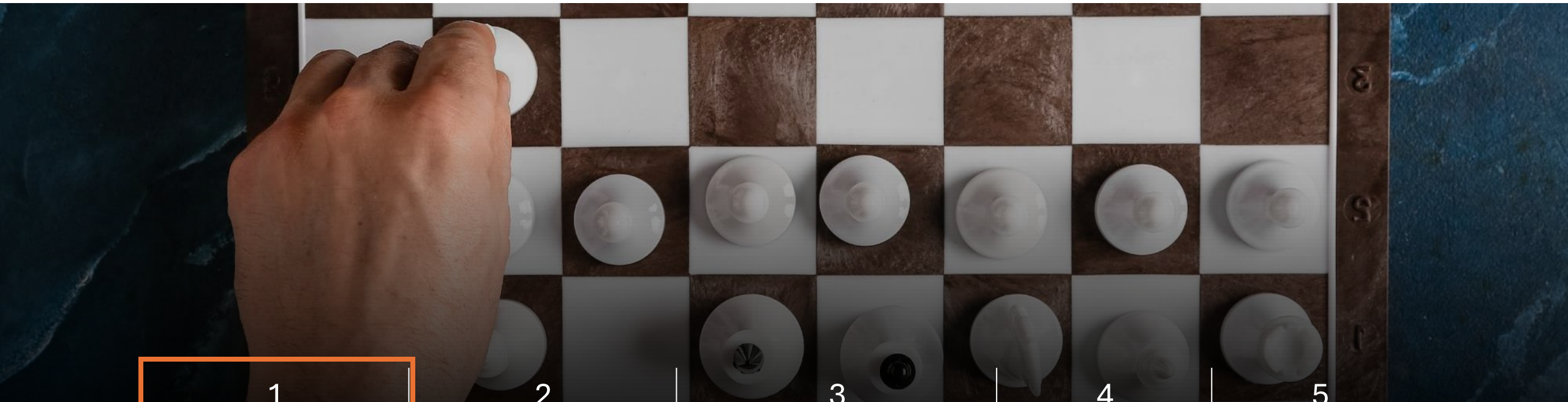
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Why are we here?	Game Theory 101	Game Theory in Procurement	Auctions	Case Studies



Companies and governmental bodies are overpaying for their procurement spend because suppliers do not have the right incentives to lower their prices



There is traditionally a **high reluctance** to switch suppliers



Suppliers perceive this reluctance to switching and **act accordingly**



Over time procurement gets **locked in** with and **dependent on** the same suppliers

Traditional negotiation techniques do not give suppliers strong incentives to lower their prices



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As a result, procurement organizations in the private sector are turning to game theory to help regain the advantage in their negotiations

- Investing in a dedicated Game Theory Center of Excellence within their procurement organization
- Working with external Game Theory consultants who advise on negotiation strategy and execution
- Investing in e-sourcing platforms with flexible auction platforms that enable the use of game theory in negotiation design

Examples of leading companies with a Game Theory Center of Excellence



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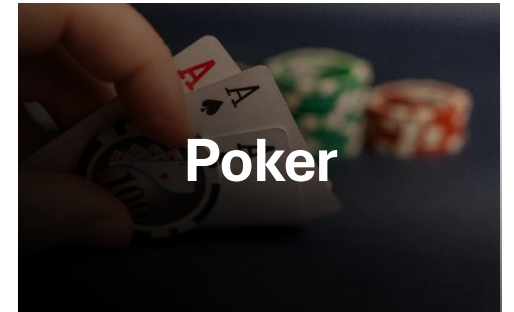
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What is Game Theory?

GAME THEORY IS THE STUDY OF INTERACTIVE DECISION MAKING WHERE THE OUTCOME FOR EACH PLAYER DEPENDS ON THE ACTIONS OF ALL

Game theory
is relevant >

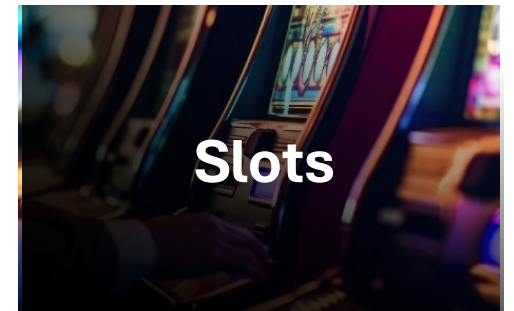
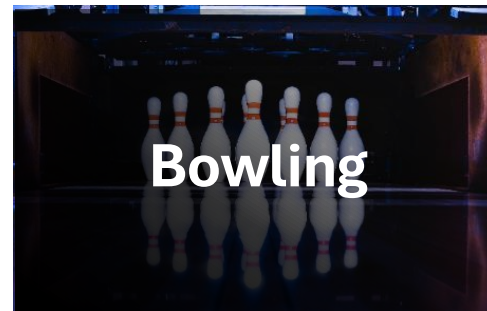
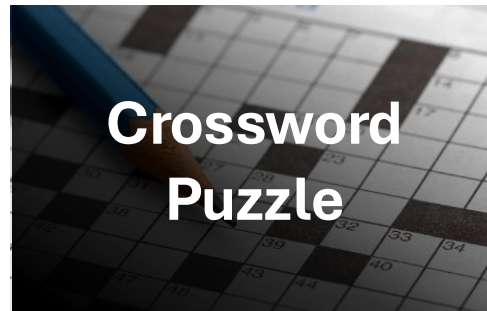


vs.

vs.

vs.

Game theory
is not relevant >



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How to define and solve games

A **Game** is defined by



Players



Strategies



Payoffs

You can predict the outcome of a game by finding the **equilibrium**

In equilibrium, **no player** can unilaterally change their **strategy** in order to improve their **payoffs**



To test whether an outcome is the equilibrium ask:
Does any player have an **incentive** to deviate from their current strategy?

NO

The game is in equilibrium

YES

The game is not in equilibrium



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The Prisoners Dilemma

- Two criminals rob a bank and hide the money
- They get arrested and are being interrogated in separate rooms
- They each get asked to “deny or confess”
- They must decide simultaneously



Players

Criminal 1
Criminal 2



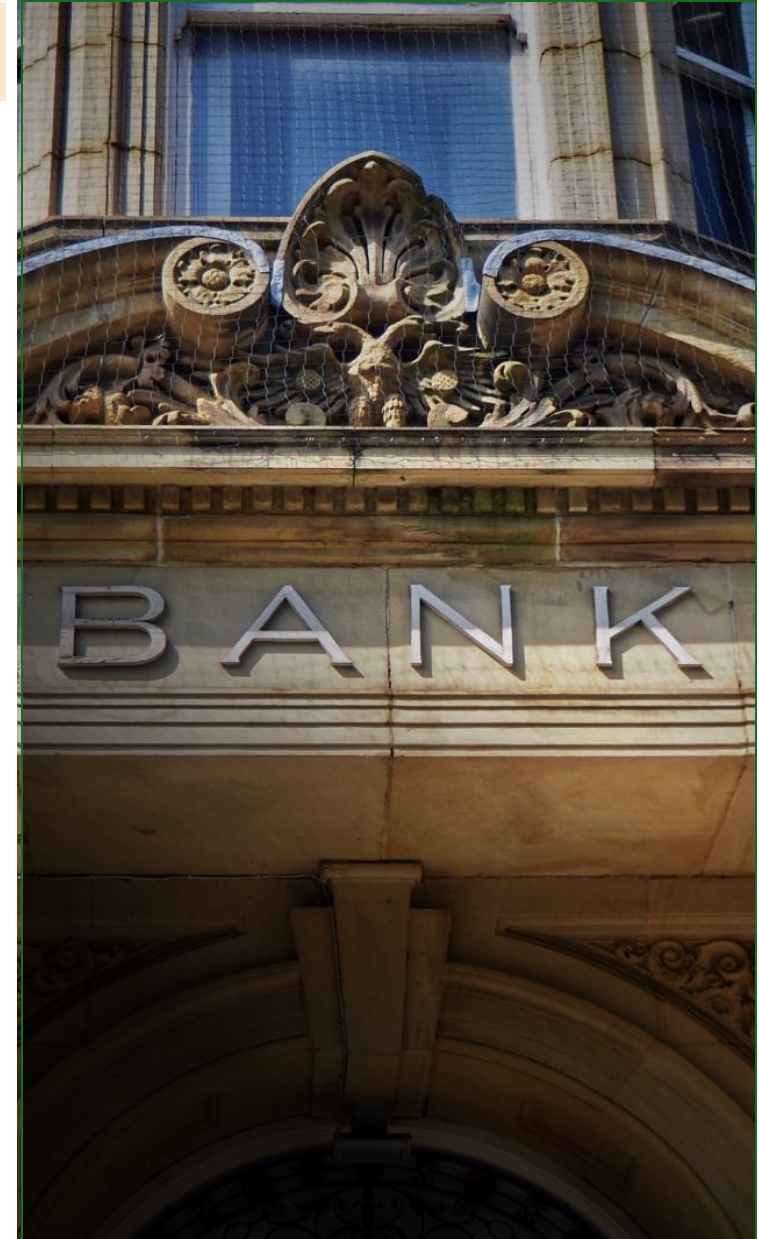
Strategies

Deny
Confess



Payoffs

Both deny: 1 year
Both confess: 6 years
One confesses/one denies:
Confessor gets: 0 years
denier gets: 10 years



The Prisoners Dilemma

		Criminal 1	
		Criminal 1 chooses to confess	Criminal 1 chooses to deny
Criminal 2	Criminal 2 chooses to confess	6 / 6	10 / 0
	Criminal 2 chooses to deny	0 / 10	1 / 1

Payoffs

Both deny:	1 year
Both confess:	6 years
One confesses:	0 years
Denier gets:	10 years



The Prisoners Dilemma

		Criminal 1	
		Criminal 1 chooses to confess	Criminal 1 chooses to deny
Criminal 2	Criminal 2 chooses to confess	6, 6	10, 0
	Criminal 2 chooses to deny	0, 10	1, 1

Finding the solution

If both deny

One has an incentive to deviate

Are we in equilibrium?

The other has incentive to deviate

Are we in equilibrium?

Confess – confess is the equilibrium



The Prisoners Dilemma

		Criminal 1	
		Criminal 1 chooses to confess	Criminal 1 chooses to deny
Criminal 2	Criminal 2 chooses to confess	6, 6	10, 0
	Criminal 2 chooses to deny	0, 10	1, 1

Finding the best response

If Criminal 1 confesses...

Criminal 2's best response is to Confess

If Criminal 1 denies...

Criminal 2's best response is to Confess



The Prisoners Dilemma

		Criminal 1	
		Criminal 1 chooses to confess	Criminal 1 chooses to deny
Criminal 2	Criminal 2 chooses to confess	6, 6	10, 0
	Criminal 2 chooses to deny	10, 0	1, 1

Finding the best response

If Criminal 2 confesses...

Criminal 1's best response is to Confess

If Criminal 2 denies...

Criminal 1's best response is to Confess



The Prisoners Dilemma

		Criminal 1	
		Criminal 1 chooses to confess	Criminal 1 chooses to deny
Criminal 2	Criminal 2 chooses to confess	6, 6	10, 0
	Criminal 2 chooses to deny	10, 0	1, 1

Result

No matter what the other person does, the prisoner will always do better if they confess!

Confess is always the best response





The outcome of the Prisoners dilemma is no coincidence – It was forced by the payoffs and rules set by the policeman

A different design would have resulted in a different outcome!

What if the prisoners were allowed to talk before their decision?

What if the payoffs for confessing and denying were different?

What if the prisoners made their decisions sequentially?

The policeman used **mechanism design** (game design) to shape the prisoners dilemma to optimize its outcome

Setting the rules of the game gives the **advantage to the rule setting party** (the policeman)



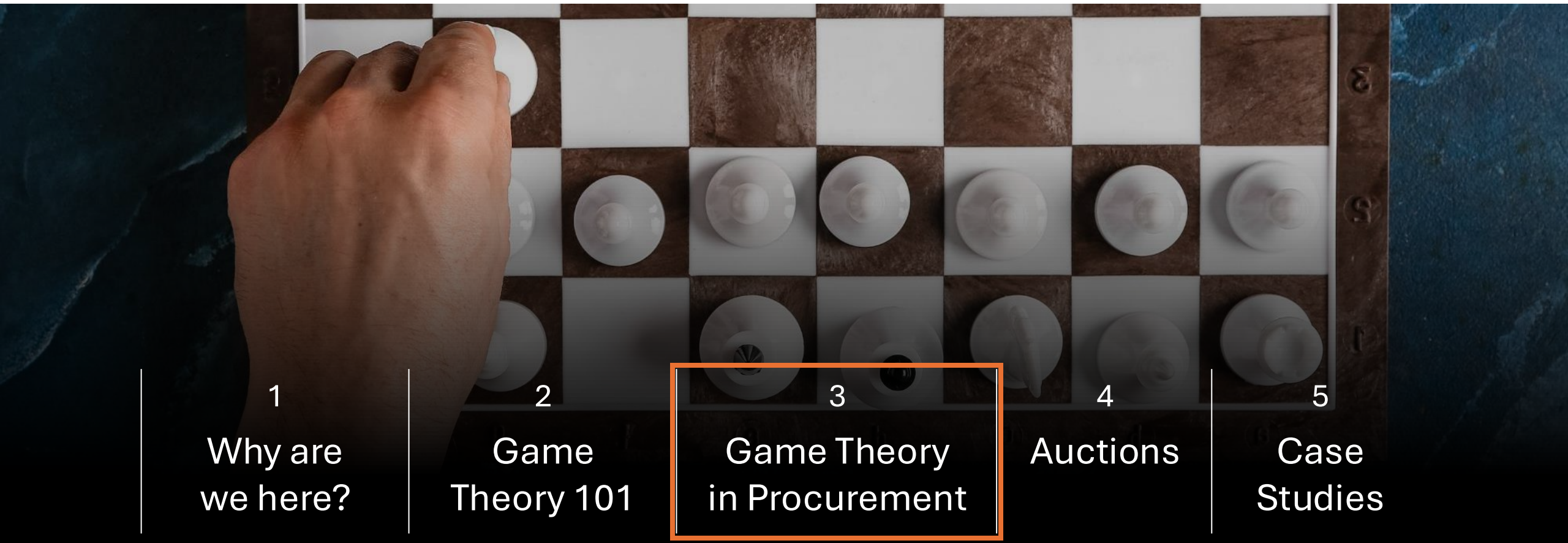
**In supplier negotiations,
procurement is the policeman!**



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The Suppliers Dilemma

- Two suppliers with **equal cost structures** (and quality) compete for your business.
- Suppliers can either offer a “**high price**” or “**low price**”
- The **lowest offer** is awarded the full business
- If both offer the same price, the business is split **equally**.
- Total profit at **high price: \$6M**; total profit at **low price: \$4M**
- The offers must be made simultaneously



Players

Supplier A
Supplier B



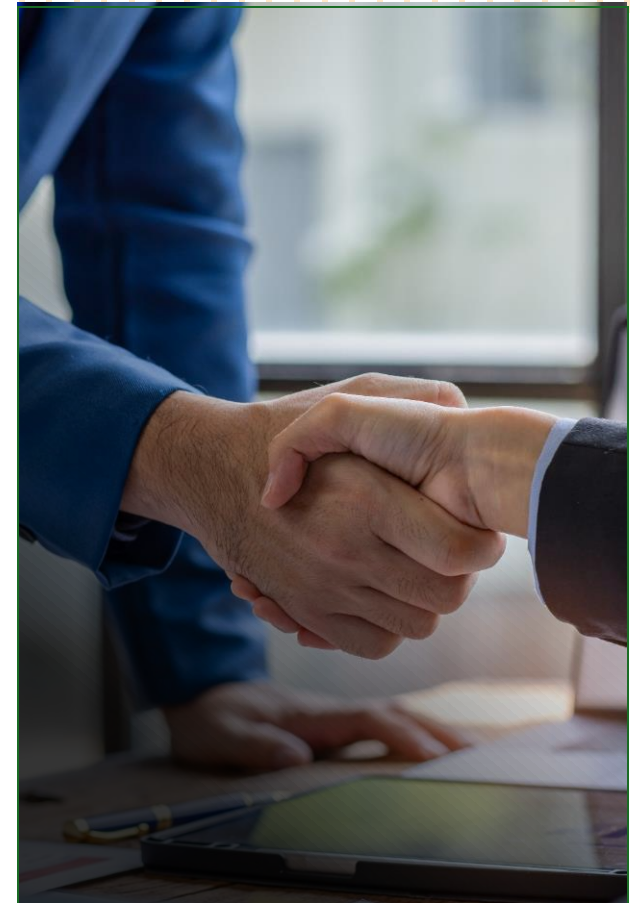
Strategies

High Price
Low Price



Payoffs

Both offer high price:	3M	One high/one low:	
Both offer low price:	2M	Low price gets :	4M
		High price gets:	0M



The Suppliers Dilemma

		Supplier A	
		Supplier A offers Low price	Supplier A offers High price
Supplier B	Supplier B offers Low price	2M / 2M	0 / 4M
	Supplier B offers High price	0 / 4M	3M / 3M

Payoffs

Both offer high price:	\$3M
Both offer low price:	\$2M
One offers low price:	\$4M
High price gets:	0



The Suppliers Dilemma

		Supplier A	
		Supplier A offers Low price	Supplier A offers High price
Supplier B	Supplier B offers Low price	2M / 2M	0 / 4M
	Supplier B offers High price	0 / 4M	3M / 3M

Finding the solution

If both offer a high price
 One has an incentive to deviate
 Are we in equilibrium?
 The other has incentive to deviate
 Are we in equilibrium?

Low – Low is the equilibrium

Suppliers want to end up in a high-priced market, but the payoffs and rules forced them to offer low!



A Suppliers Dilemma is one example of Mechanism Design



Mechanism Design can be thought of as “reverse game theory”. Instead of solving games, we are designing games or strategic interactions in order to optimize their outcomes

As the game designer, procurement starts every negotiation with an advantage!



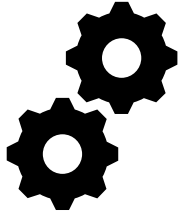
Setting the rules of the negotiation gives the advantage to the rule setting party (the buyer)

		Supplier A	
		Supplier A offers Low price	Supplier A offers High price
Supplier B	Supplier B offers Low price	2M / 2M	0 / 4M
	Supplier B offers High price	0 / 4M	3M / 3M

In the supplier’s dilemma, we designed a game to ensure the lowest price outcome was achieved



To select the best rules for your procurement “game”, think about the incentives that different rules create for the players



The **RULES** set by the game designer (procurement)...



...influence the **INCENTIVES** faced by the players in the game (suppliers)...



...which determine the **OUTCOME** of the game

Actively and iteratively designing the rules of the negotiation is the basis for its success



As the game designer, procurement can specifically design their supplier negotiations in a way to optimize their outcomes



Players

- Which suppliers should be included or excluded?
- Is there an incumbent supplier? How many challenger suppliers to invite?
- How many suppliers to include in the final auction?



Strategies

- What is the negotiation format?
- Are we doing an auction?
Bilateral negotiation?
- Should suppliers make offers to us, or we make offers to them?
- What are the tiebreak rules?



Payoffs

- How long is the contract duration? (What is the size of the business?)
- Should we dual source or single source?
- If we dual source, how should we split the shares?



Information

- What information should be shared with suppliers?
- Should suppliers know about the level of competition / where they rank among the competition?
- When and how should we share information with suppliers?





Players

Defining the set of players (suppliers)

YOUR POWER POSITION WITH YOUR SUPPLIERS IS A KEY INPUT INTO YOUR NEGOTIATION STRATEGY

Suppliers



Who are the eligible suppliers?

Existing suppliers

New suppliers



How much spend can they win?

Minimum required spend

Maximum potential spend

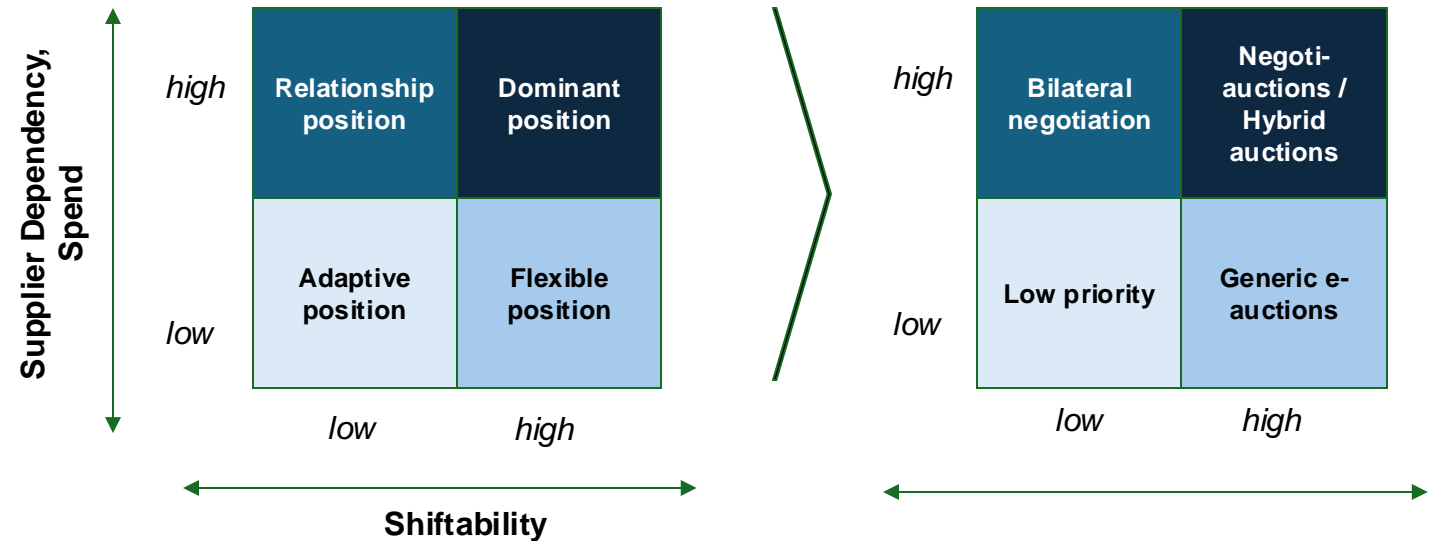
Suppliers – Buyer Power Matrix



What is the power balance between you and those suppliers?



What does that mean for your negotiation strategy?



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Defining the rules of the negotiation (and the strategies available to the players)

INPUTS TO AWARD DESIGN

- # Number of suppliers
- Challenger vs. incumbent
- \$ RFQ analysis
- Danger of collusion
- Strategic objectives
- Future business
- Market shares of suppliers
- Technologies used by bidders

EXAMPLES OF AWARD DESIGN OPTIONS

- | | | |
|------------------------|-----|----------------------|
| Auction | vs. | Sequential |
| Bilateral negotiation | | Simultaneous |
| ----- | | |
| Ascending auction | vs. | Single round |
| Descending auction | | Multi-round |
| ----- | | |
| Price-based | vs. | Tool makes offers |
| Price & criteria based | | Suppliers makes bids |

TAILORED AWARD DESIGN

- Negotiation format
- Bidding language
- Information transparency
- Starting prices
- Bid increments / decrements
- Competition measures



Determining the payoffs available to suppliers



Single year vs. multi year contract

- **Single year preferred** when flexibility is critical, when market conditions are volatile, or when there are uncertainties around budget constraints
- **Multi year preferred** for cost savings, when there is stable or forecasted demand, to foster long-term relationships, and to reduce the administrative burden of re-negotiating



Single source vs. multi source

- **Single source preferred** when the buyer wants more leverage, when there is low risk or minimal impact of supply chain disruptions
- **Multi source preferred** to ensure continuity of supply (if there are large risks to supply chain disruptions), when the buyer wants to preserve competitive tension for the duration of the contract



Symmetric shares vs. asymmetric shares (if dual sourcing)

- **Symmetric shares (i.e. 50/50) preferred** when buyer wants to maintain balance and competition between suppliers, to maintain flexibility
- **Asymmetric shares (i.e. 80/20) preferred** when savings are prioritized (a buyer can create a must-win battle for the large share to incentivize savings on both shares)



Managing suppliers' beliefs with selective information

MAKING THE SUPPLIERS DILEMMA MORE REALISTIC

Setup

Total profit at **high** price: **\$6M**

Total profit at **medium** price: **\$5M**

Total profit at **low** price: **\$4M**

Incentives

Suppliers form **beliefs** about incomplete information and **act** accordingly.

Perceived competition: Suppliers might **believe** there is competition even though there is **none/limited**

A's belief about supplier B

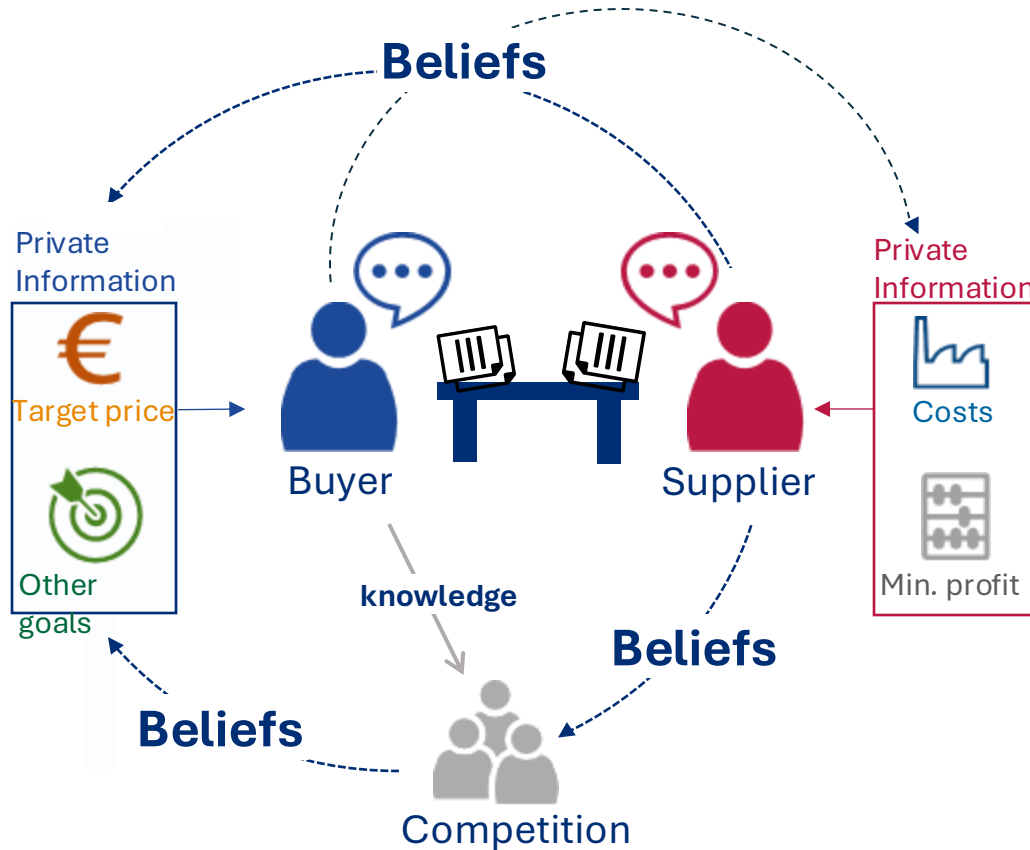
		A's belief about supplier B			
		Low	Medium	High	No competitor
Price Supplier A	Low	2, 2	4, 0	4, 0	4, 4
	Medium	0, 4	2,5, 2,5	5, 0	5, 5
	High	0, 4	0, 5	3, 3	6, 6

If possible, Suppliers will offer a lower price than what they believe their competitors will offer





Managing suppliers' beliefs with selective information



Buyer and Sellers Objectives

- Hide their private information
- Form beliefs about their counterpart's private information
- Influence the beliefs of their counterpart

Keeping suppliers in the Suppliers' Dilemma by managing their beliefs is the challenge of procurement!

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Many companies are increasing their use of auctions as they are one of the strongest game theory tools during negotiations

Why use auctions?



Incentivizes suppliers to submit **more competitive offers** by making competition visible



Encourages suppliers to participate in the negotiation through **procedural fairness and transparency**



Can be **tailored to any procurement objectives** and market conditions due to variety of auction formats and rules



Eliminates stakeholder biases by letting the market decide who wins the business



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However, oftentimes organizations are reluctant to leverage auctions to negotiate their spend, citing one of several myths

Myths around Auctions



Myth

Auctions are only suitable for commodity- like categories

Reality

The market, not the category determines auction applicability; there are no “out of scope” categories



Auctions are all about price

Auctions should always be run on “Total Cost of Ownership” (TCO)



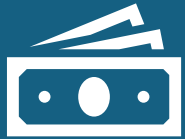
Auctions damage supplier relationships

Many suppliers like auctions because there is transparency and commitment behind the negotiation process



To run an auction, **your negotiation must meet three criteria:**

When can auctions be applied?



Business is commercially attractive to suppliers



At least two eligible suppliers



Internal commitment to award to the auction winner

The market, not the category determines auction applicability; there are no categories that are “out of scope” as a starting point!

Examples of auction categories

- Air freight
- Pallets
- Real Estate
- Construction
- Furniture
- Office supplies
- Facilities
- Rental Cars
- Consultants
- Batteries
- Packaging
- materials
- Temporary labor
- IT hardware
- IT software
- Healthcare
- Ingredients
- Cables
- Warehousing
- Ocean freight
- Plastic parts
- Raw materials
- FTL / LTL
- Finished goods
- Parcel
- Agencies
- MSP
- Marketing services
- Travel
- Resins
- HR / Benefits
- Legal Services
- Tax/ Audit Services
- Chemicals
- Printing services
- And many others.....



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Auction designs are not one size fits all and can be deliberately designed to optimize the commercial goals of the buyer



What auction format best suits the negotiation landscape and objectives?

- Dutch
- English
- Sealed Bid
- Japanese
- Etc..



How much information to give suppliers on where they stand?

- Lead or not
- Traffic light
- Ranking
- Seeing all bids
- Etc...



Should all the spend be auction simultaneously or sequentially in packages?

- How to create bundles of spend to optimize the outcome?
- When dual sourcing what share gets auctioned first?
- Etc..



What prices are the guardrails of the auction?

- What is the starting price?
- What are the bid increments?
- What is the ceiling price to award the business?
- Etc..



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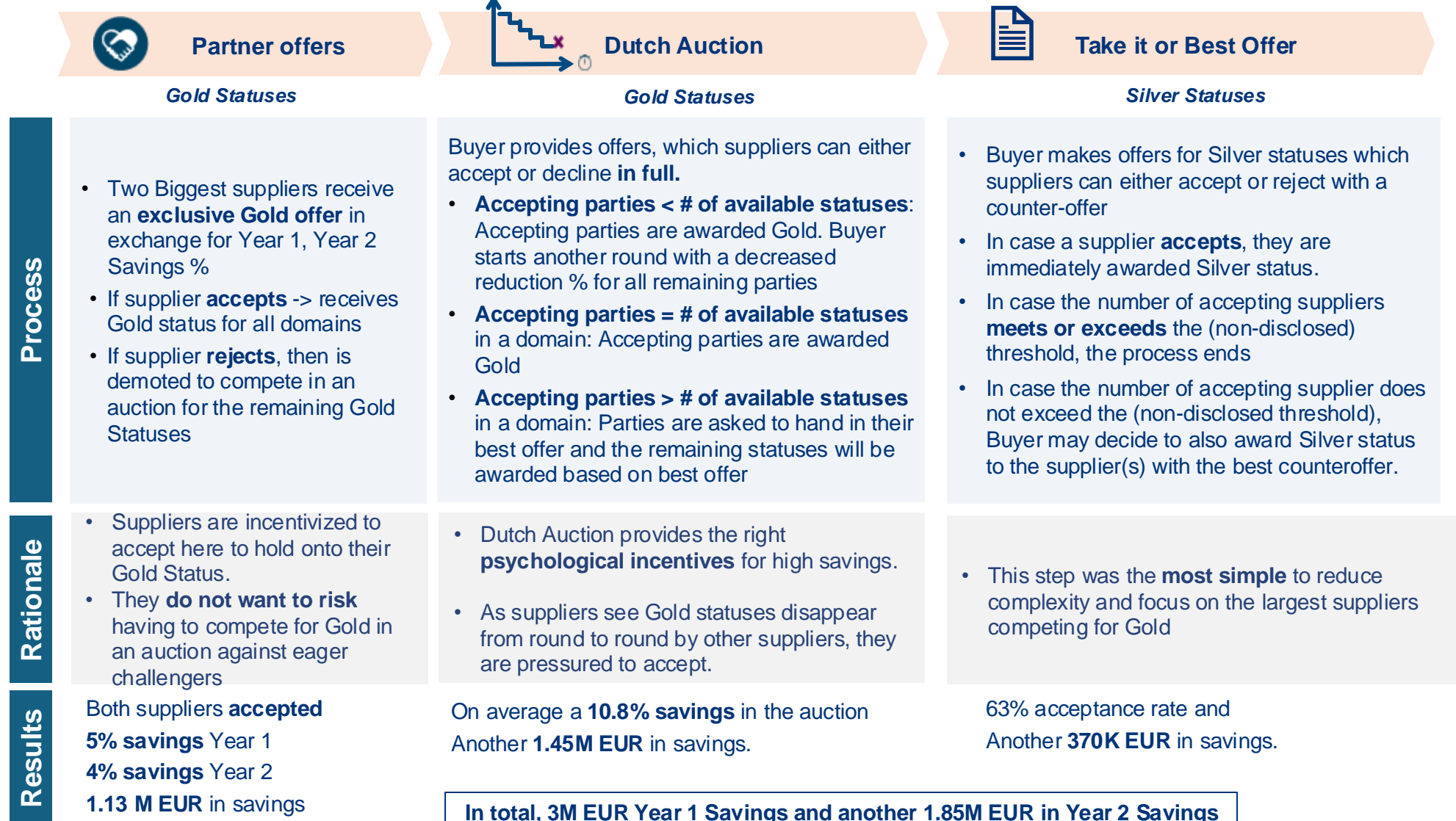
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Case Study – Contingent Workers

Situation

- **80 suppliers** in the installed base (**100M EUR/year**)
- Buyer is negotiating a percentage price down on total installed base
- Based on the % price down, supplier can be awarded a **status** that include specific advantages
- **Gold** status is for a limited number of partners and gives the most benefits
- **Silver** and **Bronze** statuses are lower, with more suppliers and less advantages
- Negotiation is for statuses for **2 years**

Negotiation Design



In total, 3M EUR Year 1 Savings and another 1.85M EUR in Year 2 Savings

Key Takeaways



Game Theory is the study of interactive decision-making where the outcome for each player depends on the actions of all players



Game theory can help procurement gain the upper-hand in their supplier negotiations



As the game designer, procurement can specifically design negotiations – by choosing the players, strategies, and payoffs – in a way to optimize their outcomes



Auctions are one of the most effective negotiation design levers as they yield more competitive offers, encourage supplier participation, and eliminate stakeholder biases



Negotiation Strategy Call (45 min)

What You Will Walk Away With:

1) Tailored Negotiation Approach

- We will assess your specific negotiation scenario(s) and identify the most effective negotiation strategy (bilateral, auction, negoti-auction, partner offers, etc)

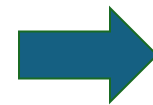
2) Determine your negotiation readiness

- Discuss the intangibles of your negotiation (e.g. supplier shiftability, stakeholder readiness, data quality, etc)

3) Action plan for implementing your strategy

- Understand your immediate next steps that need to be taken to remove blockers and set your negotiation up for success

Scan the QR
Code to
Schedule!





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Questions?