

# Risk and Expectations in *a priori* Time Allocation in Multi-Agent Contracting

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Advisor: Maria Gini



# Overview

- Introduction to MAGNET



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- RFQ formulation problem



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- Expected utility approach



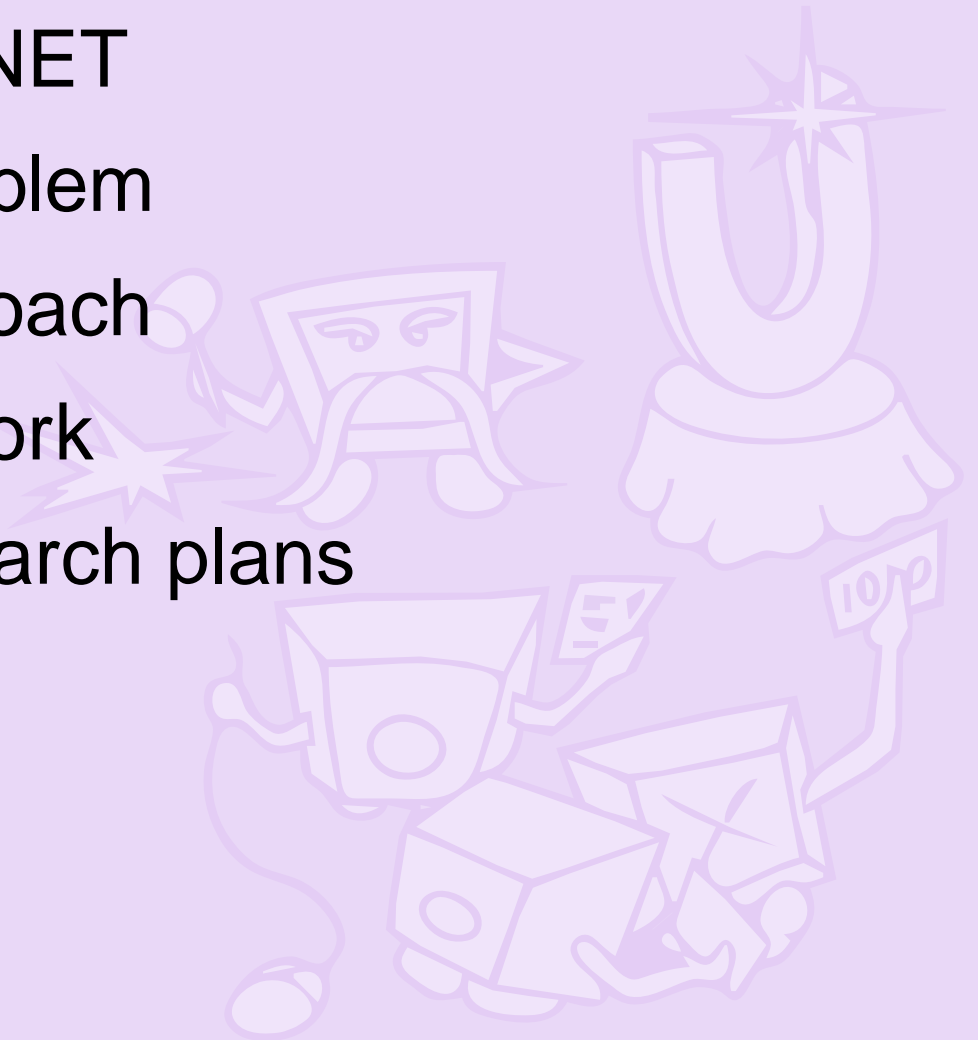
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- RFQ formulation problem
- Expected utility approach
- Evolutionary framework



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- Conclusion and research plans



# Overview

- Introduction to MAGNET [background]
- RFQ formulation problem [problem]
- Expected utility approach [solution]
- Evolutionary framework [assessment]
- Conclusion and research plans [todo]

# Introduction to MAGNET (1)

- **MAGNET**  $\equiv$  Multi-AGent NEgotiation Testbed





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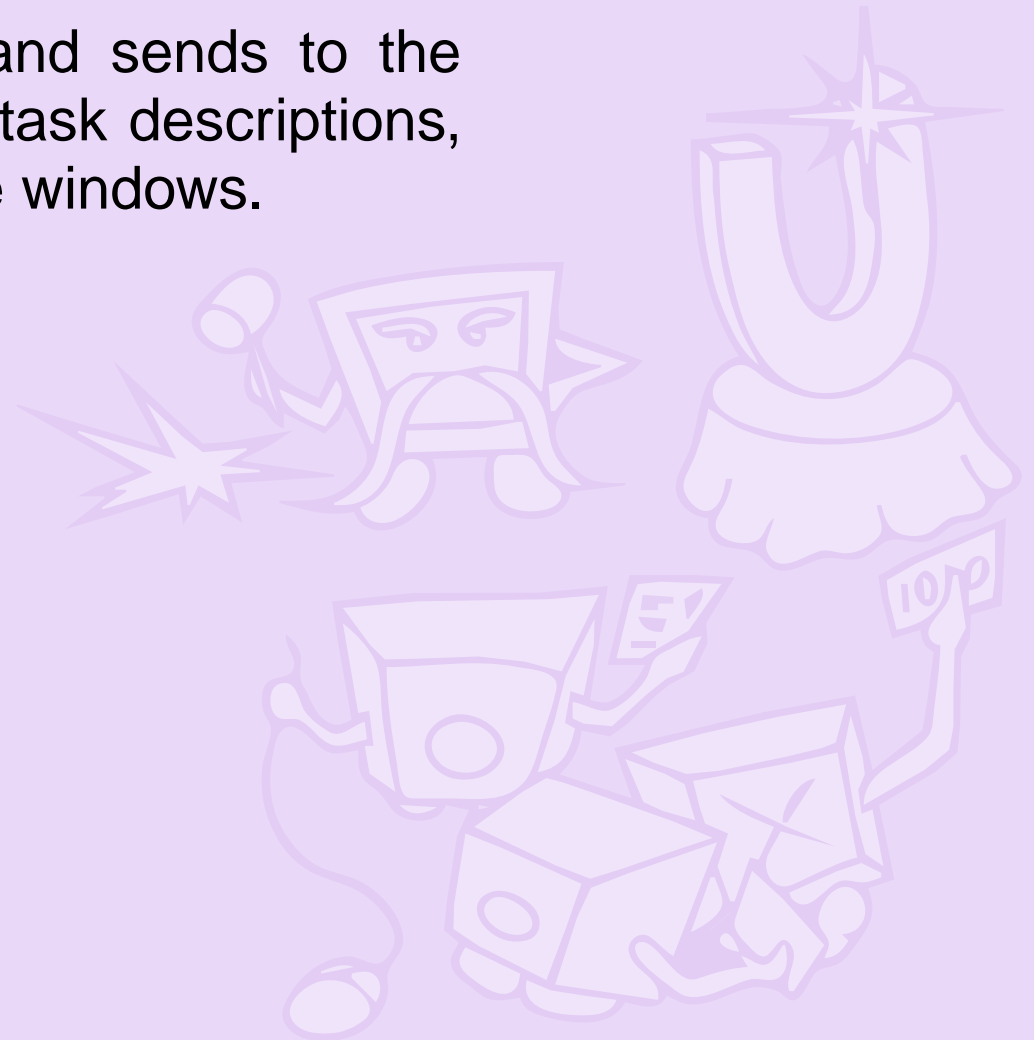
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  - negotiating contracts with temporal and precedence constraints

# Introduction to MAGNET (1)

- MAGNET  $\equiv$  Multi-AGent NEgotiation Testbed
- Current MAGNET design supports
  - multiple agents (customers and suppliers)
  - negotiating contracts with temporal and precedence constraints
  - in automated first-price sealed-bid combinatorial auction environment.

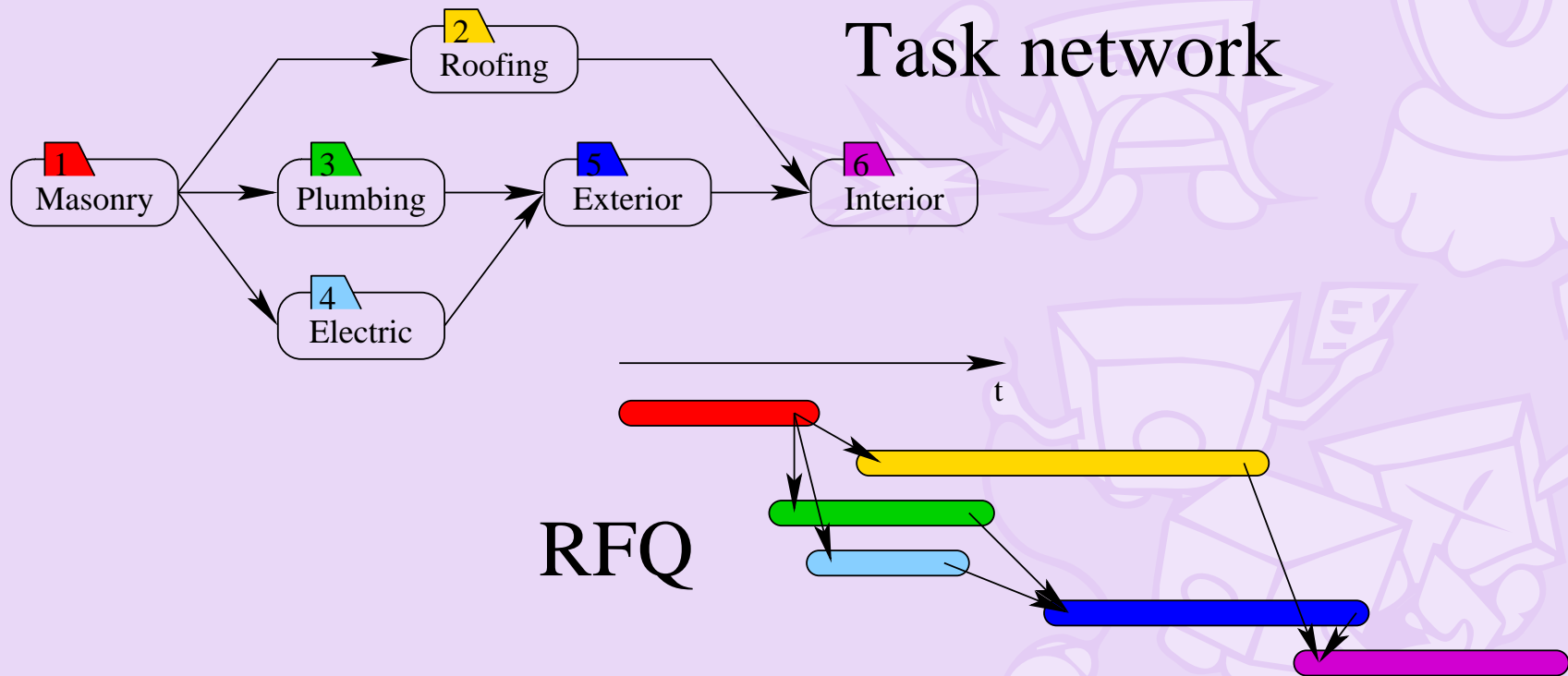
# Introduction to MAGNET (2)

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Supplier agent decides whether to participate in the auction, formulates and sends a bid.

Customer agent executes **winner determination procedure** to decide on which bundle of bids to accept, sends award and reject messages to participating suppliers.



# RFQ Formulation Problem

- Issues with conventional approach:



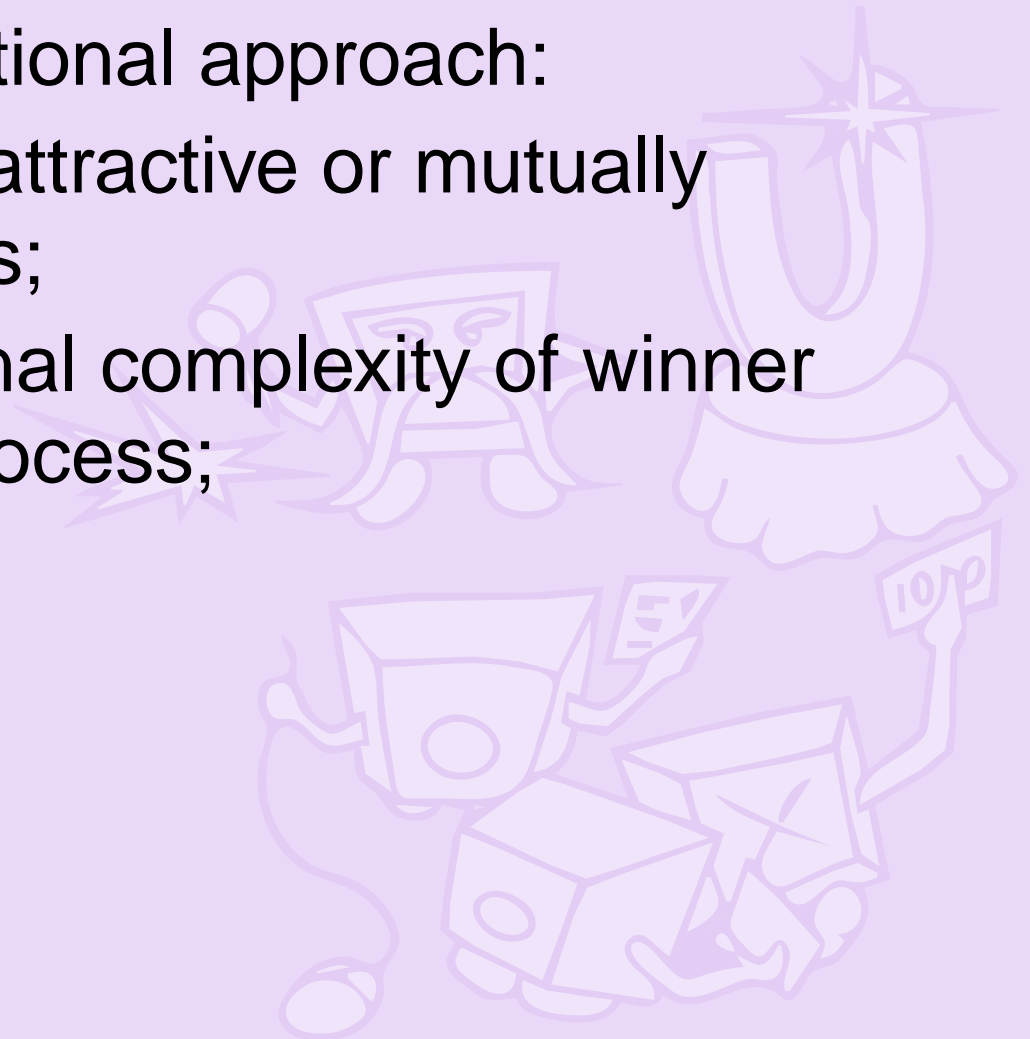
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  - solicitation of unattractive or mutually incompatible bids;
  - high computational complexity of winner determination process;
  - reputation loss due to rejection of bids.
- Proposed solution:
  - formulate RFQ based on market information and customer's preferences over risk-profit expectations.

# Expected Utility Approach (1)

- Assumptions:



# Expected Utility Approach (1)

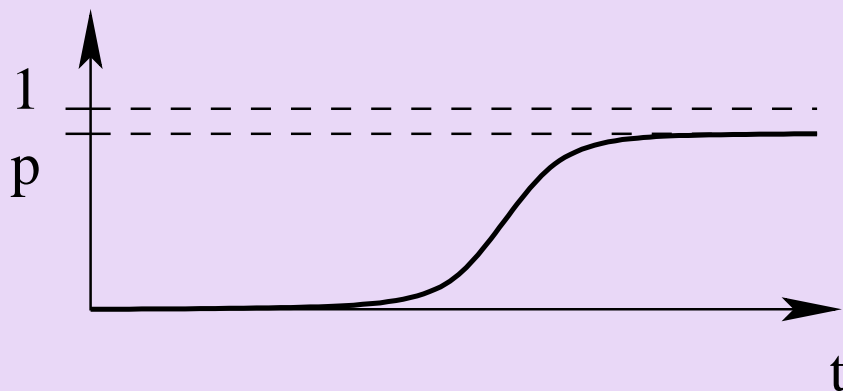
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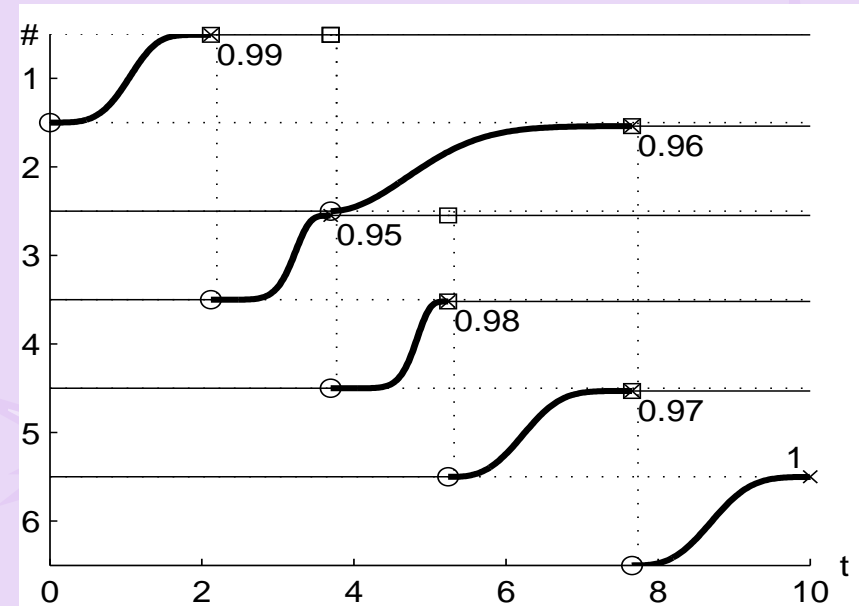
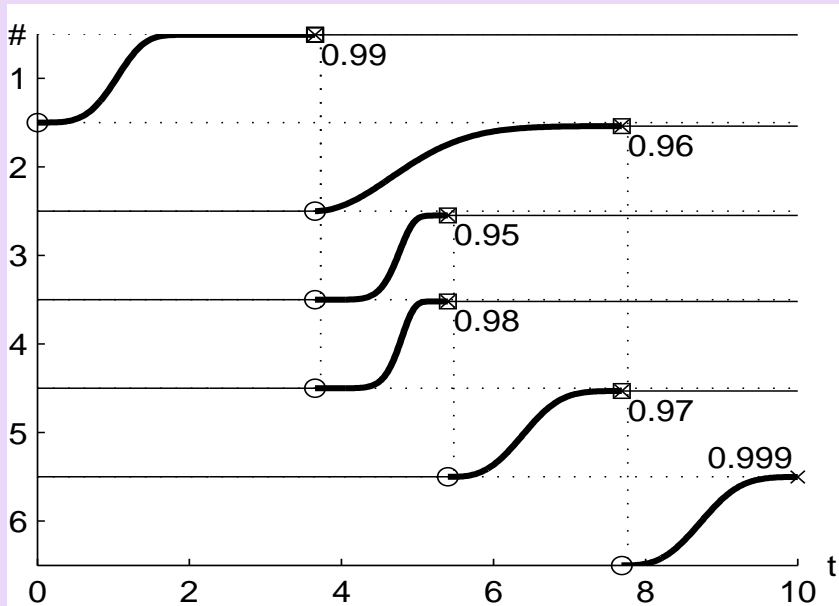


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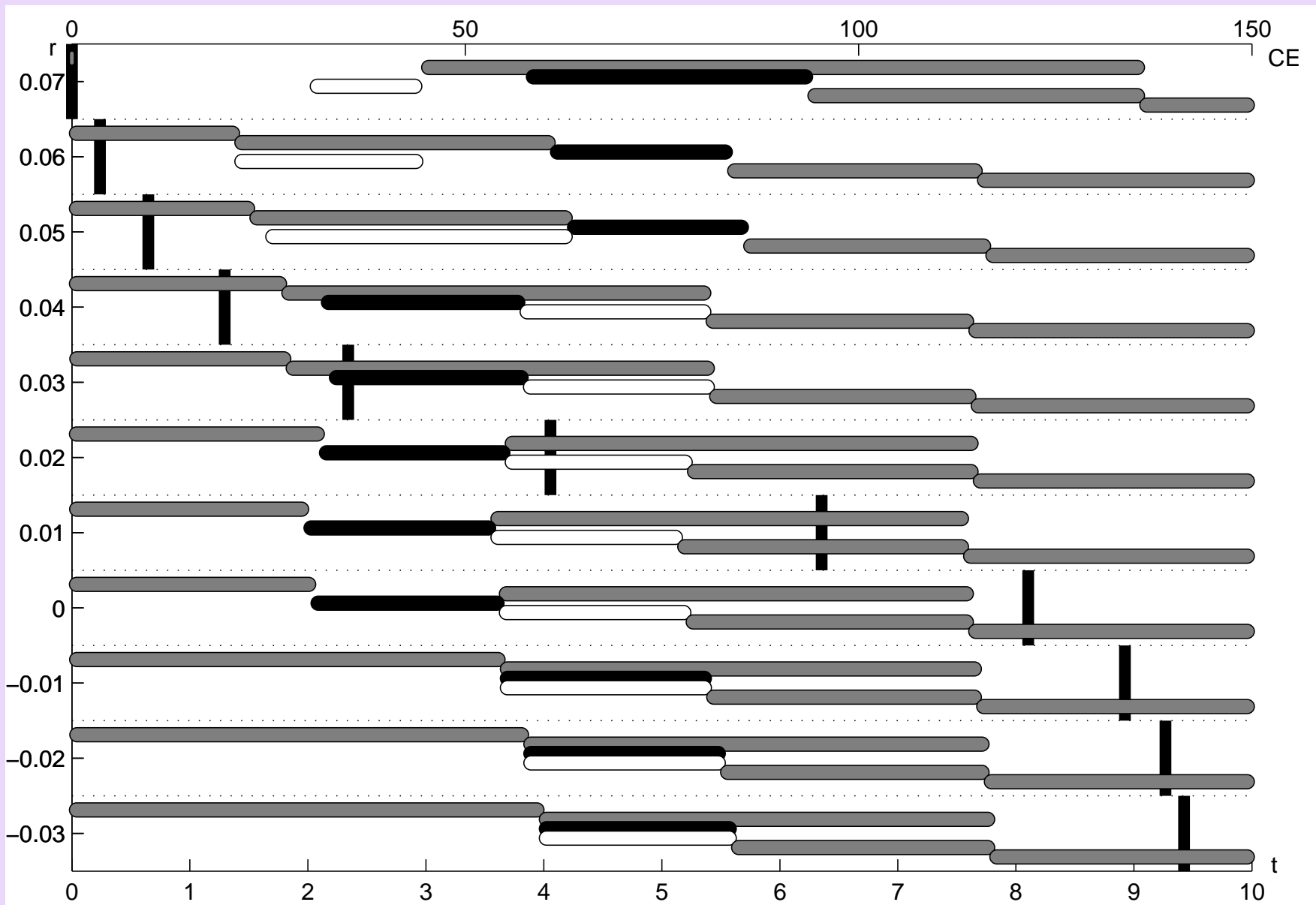
- Assumptions:
  - customer's preferences can be described by the expected utility (EU) theory;
  - customer can collect information on the cost of tasks and on the success rate as a function of time.



# Expected Utility Approach (2)



EU maximizing (i.e. ideal) time allocations for the 6-task plan shown before. Left schedule is for risk-loving agent, right schedule is for risk-averse agent.



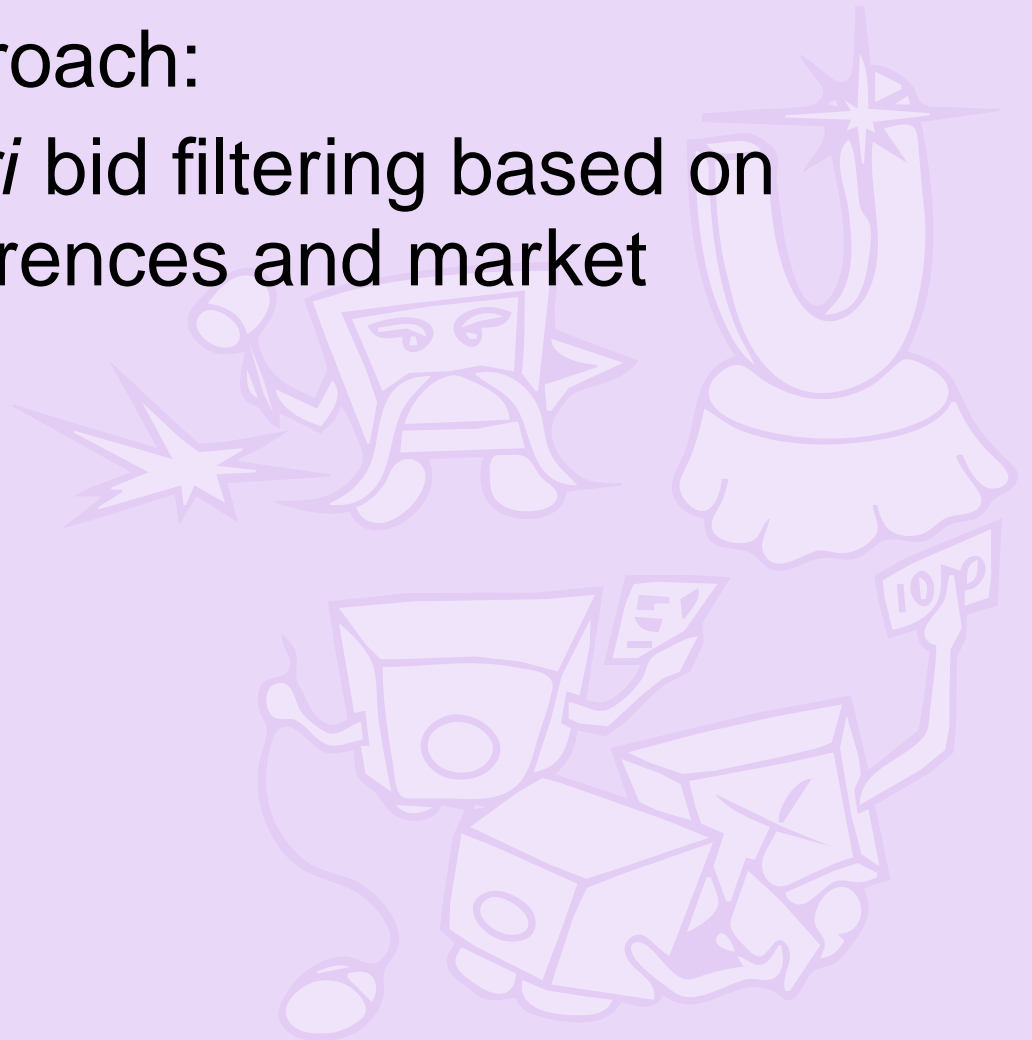
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- Benefits of EU approach:
  - allows for *a-priori* bid filtering based on customer's preferences and market information;
  - suggests intuitive relation between customer's willingness to take risk and expected profit;
  - with slight adjustment can also be used for winner determination.

# Expected Utility Approach (5)

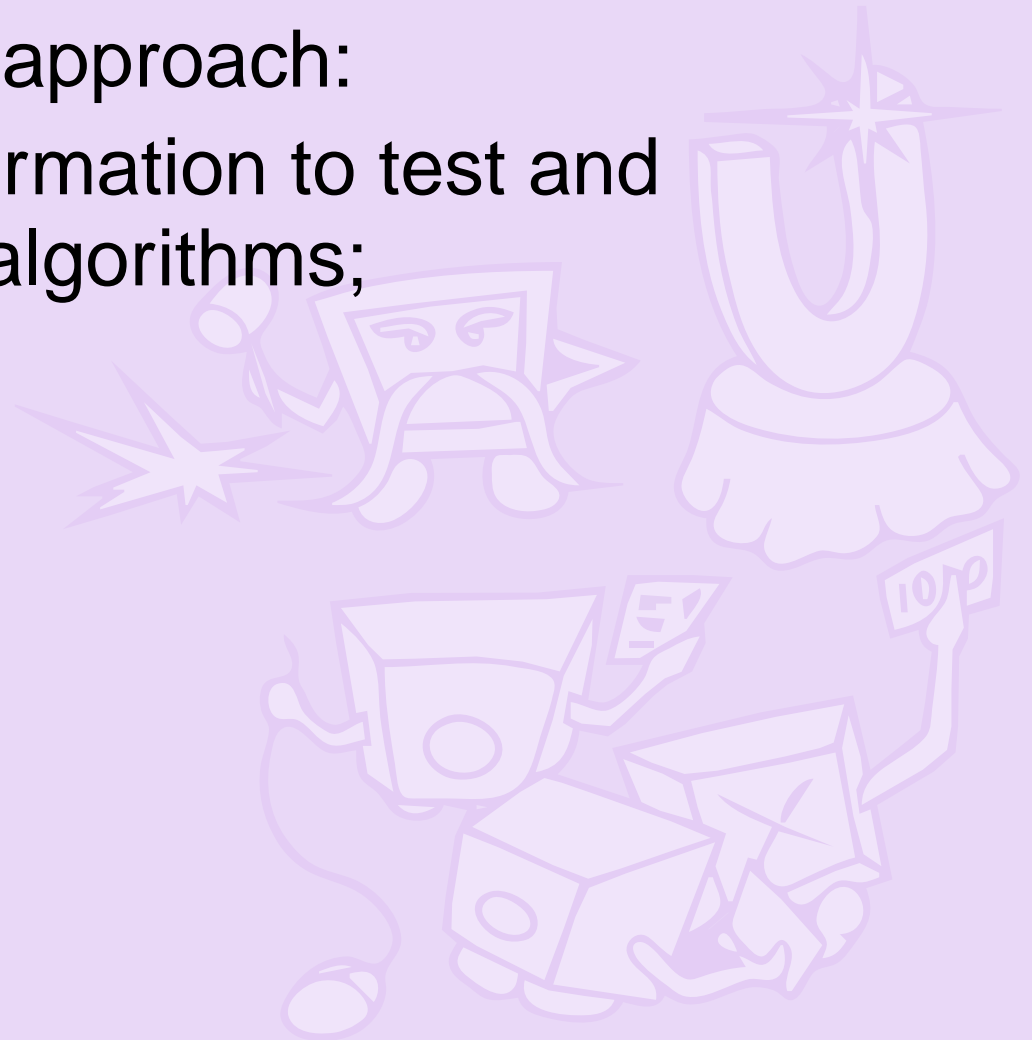
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- Open issues in EU approach:
  - need market information to test and improve related algorithms;
  - need a way of converting ideal schedule to RFQ that balances the number of incoming bids and profit expectations;
  - need a method to find optimal risk-aversity for given market.

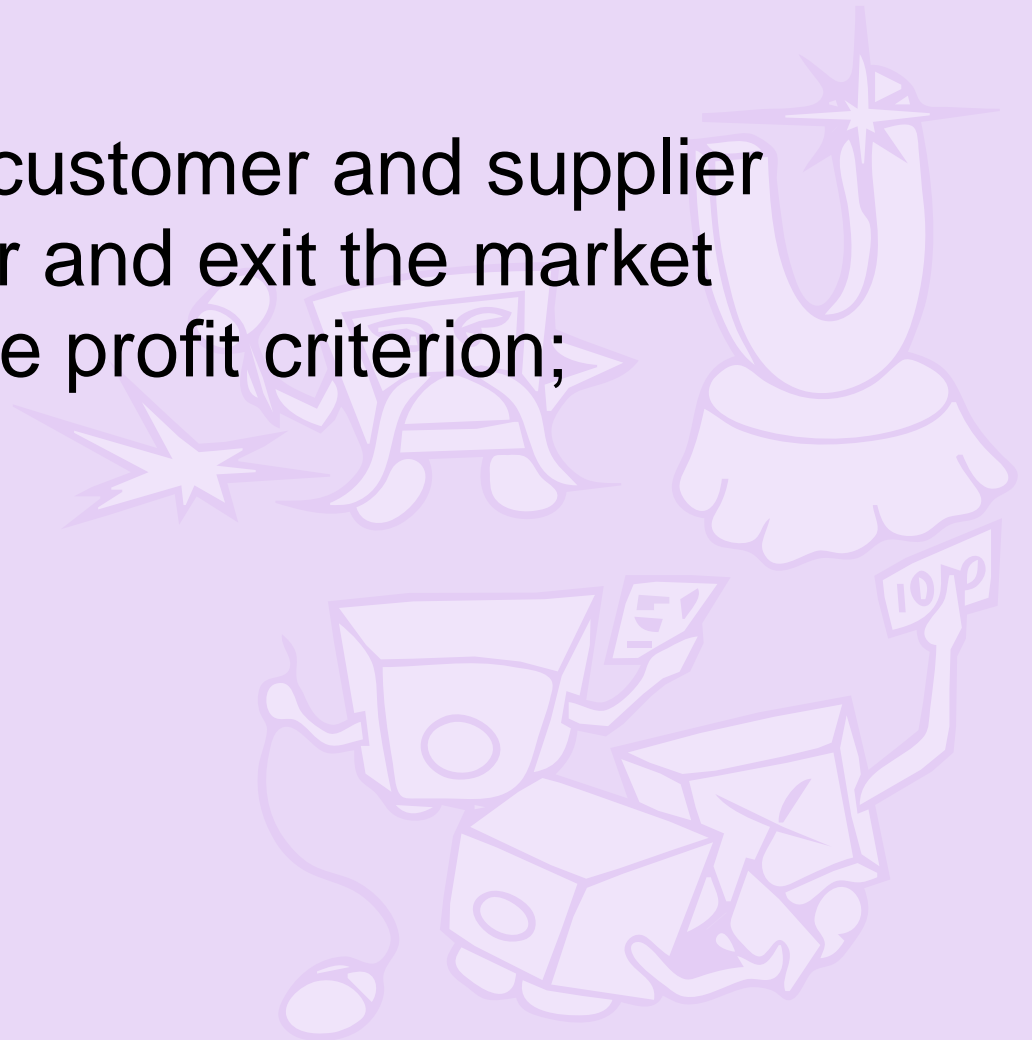
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- Setup:
  - society of many customer and supplier agents who enter and exit the market based on average profit criterion;
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  - evolutionary change of supplier agent strategies and customer agent algorithms.

# Conclusion and Research Plans

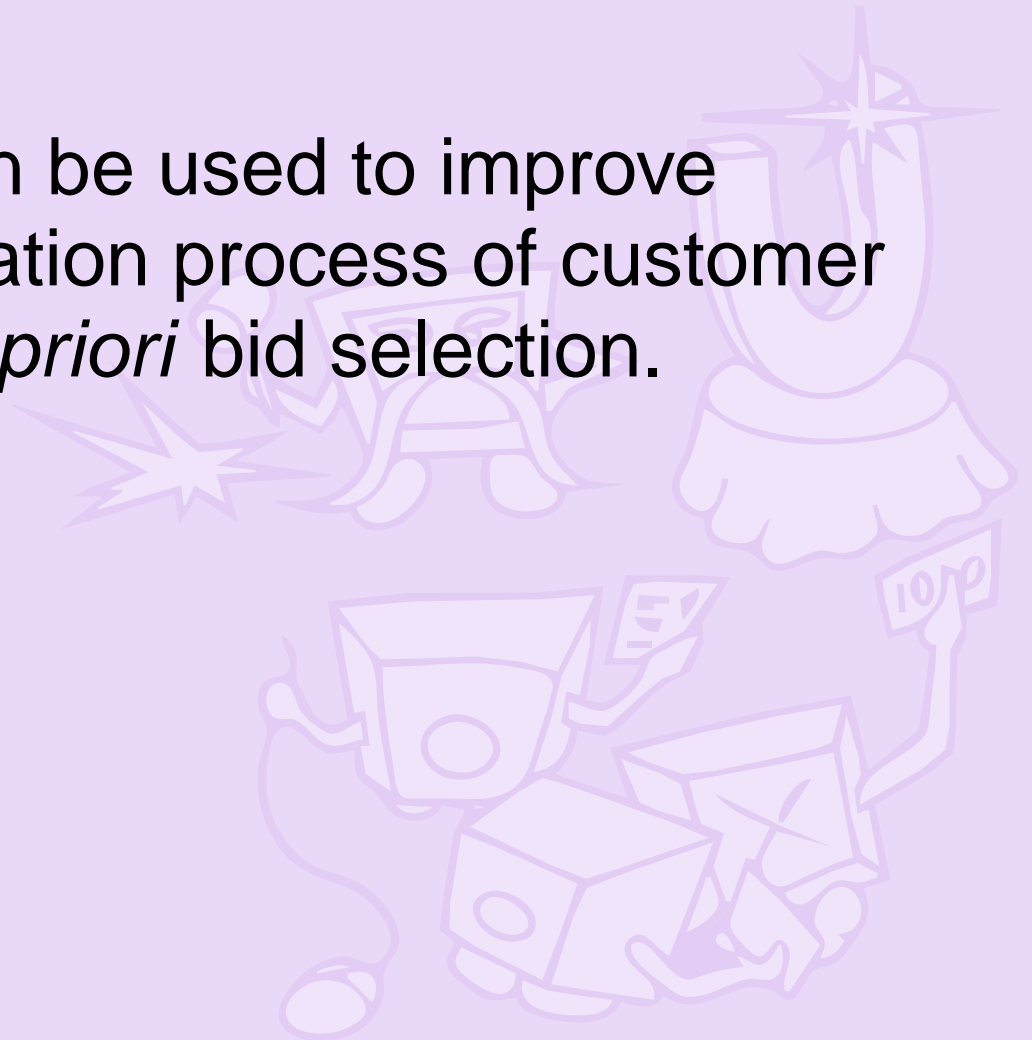
- Conclusion:





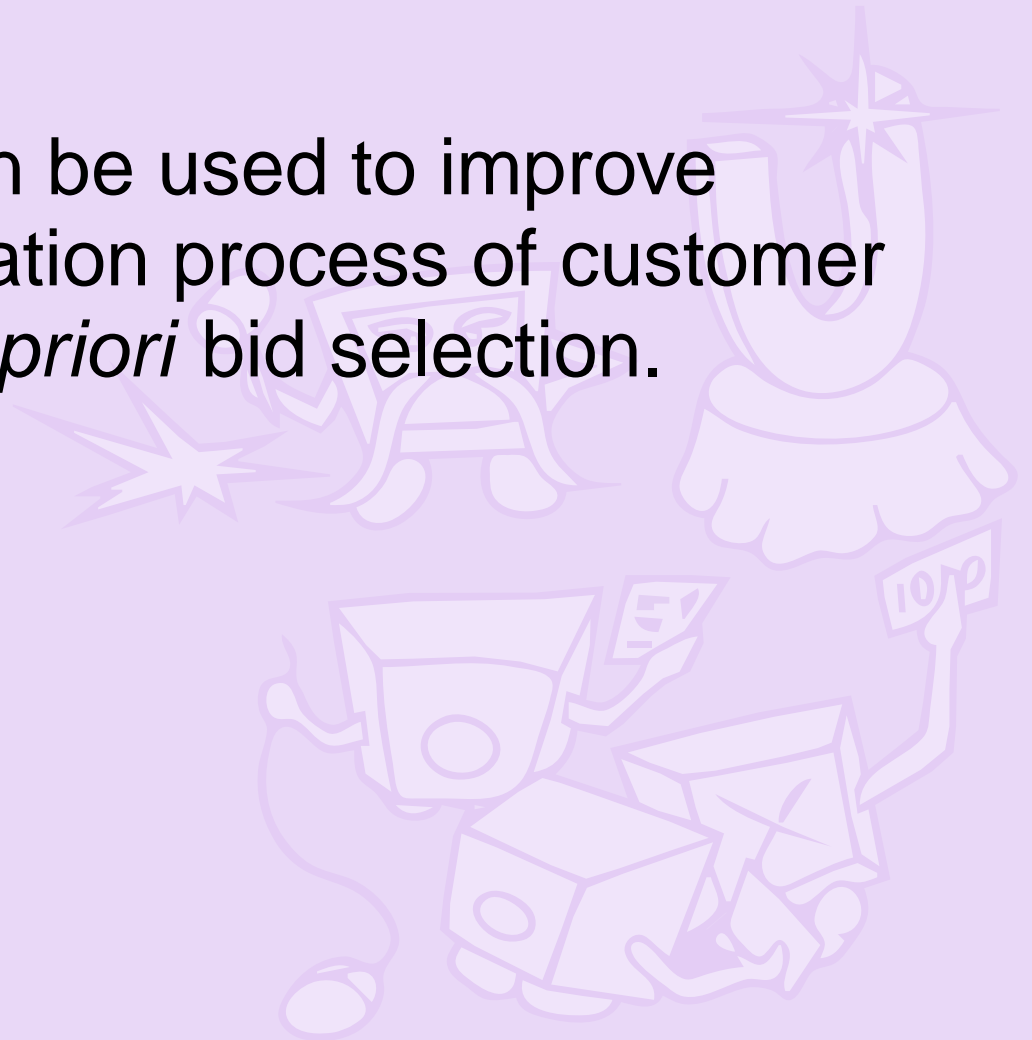
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- Conclusion:
  - EU approach can be used to improve winner determination process of customer agent through *a-priori* bid selection.
- Research Plans:
  - finalize theory of EU-based RFQ generation;
  - create evolutionary framework and use it to assess and improve the theory.

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