

Market Design Solutions for Challenges in Advanced Manufacturing

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AM Market Design Challenges

- Winner Determination Problem
 - Finding the optimal allocation of items to bidders is NP-hard [1].
 - Optimal: lead time & cost
 - Item production constraints
- Incomplete Information
 - No single party has all the relevant information
 - Information is distributed among participants
 - Participants require incentives to reveal information truthfully
- Self-Interested Market Designers
 - Incentive to develop rules that profit market owners
 - Utilize market data to obtain competitive advantage

Volume Discount Lead Time Bid (VDLT) Example

Supplier	Item	Quantity	Lead Time	Price
1	1	5	3	\$100
		10	5	\$180
		15	7	\$230
	2	1	4	\$235
	3	20	6	\$110
2	1	25	7	\$415
	2	1	2	\$112
		2	3	\$246
	3	12	8	\$45

[1] Kothari A, Parke DC, Suri S (2003) Approximately-strategy proof and tractable multi-unit auctions. In EC'03: proceedings of the 4th ACM conference on electronic commerce. ACM Press, New York, NY, USA, pp 166–175

Relevant Market Design Research

- Winner determination problem from multiple VDLT bids can be formulated as a 0-1 mixed integer program [1].
- Iterative multi-objective auction mechanisms (consistent with federal acquisition regulations) can efficiently aggregate information across participants and promote optimal outcomes for buyers and sellers [2].

[1] D. Verma, N. Hemachandra, Y. Narahari, J. Tew (2014) Applications of Multi-Criteria and Game Theory Approaches, Springer Series in Advanced Manufacturing Ch. 13

[2] Coughlan, P., Gates, W., & Lamping, J. (2008). Innovations in defense acquisition auctions: Lessons learned and alternative mechanism designs. Acquisition Research Program.

Advanced Manufacturing Auction



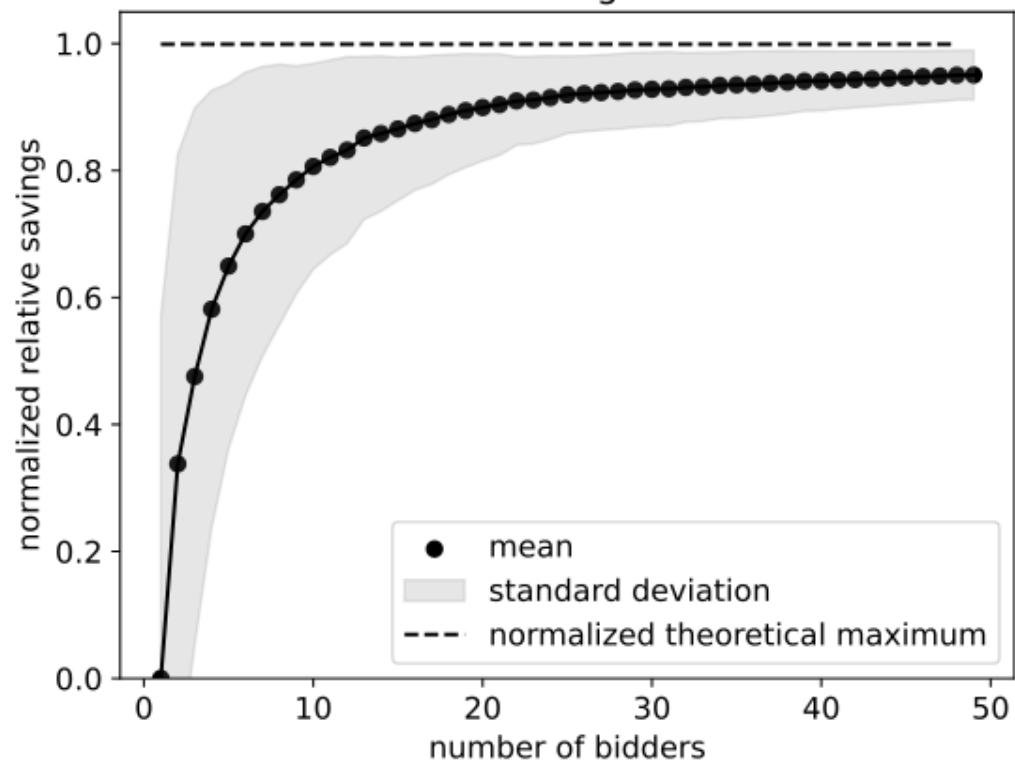
- 1) **Request Posted:** Buyer submits request to marketplace.
- 2) **Initial Bids Received:** Each supplier submits a VDLT bid.
- 3) **Optimal Allocation Posted:** The optimal allocation across bids is posted.
- 4) **Bid Updates:** Suppliers are given an opportunity to update bids based on the current allocation.
- 5) **Select:** The winning supplier is chosen based on the optimal allocation with updated bids.

MITRE's AM Marketplace

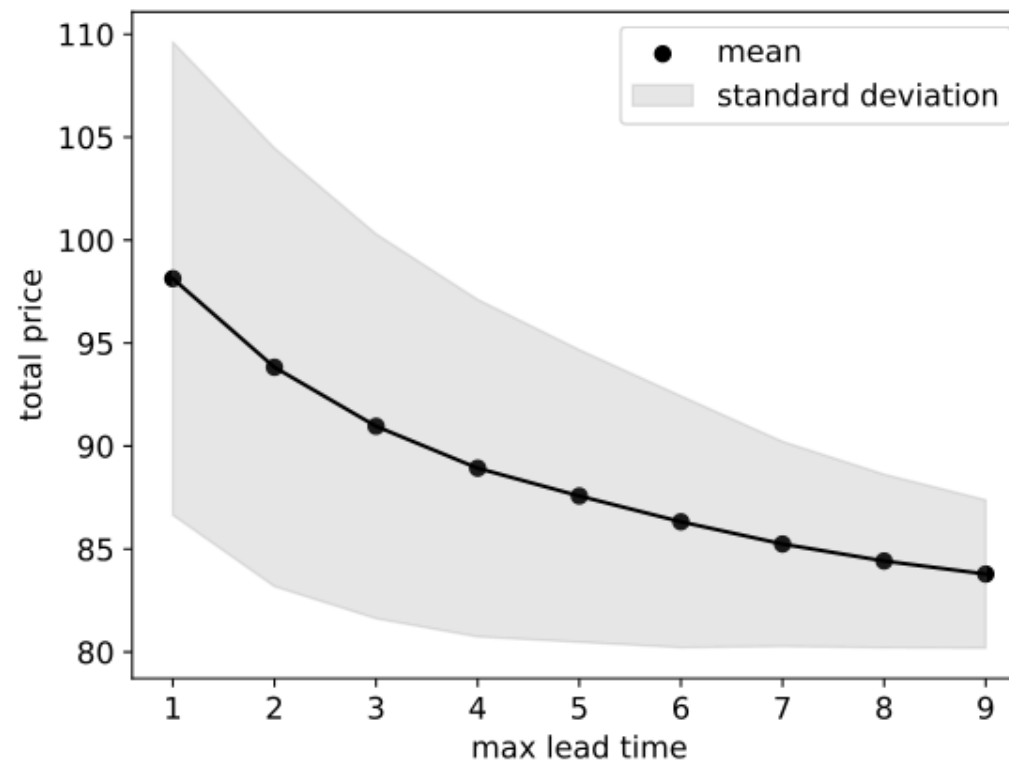
- Multiple Auction Formats
- Allocation Optimization Routine
 - multiple lead time constraints
 - quantity constraints
 - price & lead time optimization
 - item dependency constraints
- Public & Private Requests For Quote
- Costing Tool Compatibility
- Personalized Recommendations

Results

Savings



Lead Time Constraints



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