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E-PROCUREMENT: IMPLEMENTATION CASE STUDY OF A MULTI ATTRIBUTE, MULTI ITEM NEGOTIATION MODEL

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ABSTRACT

The theory of E-procurement or reverse auctions assumes that the pre-requisite to the requirements are met prior to conducting auction. Reverse auctions allows a user to conduct auctions over quality, cost and delivery based attributes in an efficient way. E-auction ensures higher market efficiency through a transparent way of negotiation. This paper focuses on different types of reverse auction processes, step by step implementation of E-procurement or reverses auction process and potential gains after implementation.

KEYWORDS : E-Procurement , Multi Attribute, Multi Item Negotiation Model, reverse auction processes.

INTRODUCTION

Procurement of any material usually deals with basic assumption of negotiating on the basis of price. All others pre-requisite are assumed to have been fulfilled. It is a highly common situation of an individual involved in multi-attribute and multi-item are simultaneously.

Recently, multi-attribute, multi item reverse auctions have become a popular means of automating this process further. The negotiable attributes (technical, quality etc.) are defined well in advance, and suppliers can compete through e-procurement. This process allows more degrees of freedom for suppliers in formulating their bids, while at the same time it leverages the competitive forces of an auction to drive the negotiation to equilibrium. Expected gains of multi-attribute auctions are increased speed of the negotiation, higher market transparency, as well as higher degrees of allocative efficiency (Bichler and Kalagnanam, 2005).

For example, an automobile manufacturer needs to buy castings, gear boxes, valves, pumps etc. There are different kinds of castings, cylinder head, cylinder block, piston, chain cover and all of them can be supplied by a single or multiple suppliers. Therefore, buyer will negotiate the multi-item at the same time with the single or multiple vendors. While negotiations things to keep in mind are the vendor should meet all requirements of quality, cost and delivery.

To maximize the benefit of the multi attribute, multi item auctions, auction mechanism to be extended to more complex mechanism. Few of them are closed bid, open to all, single bid, bindle bid etc.

There are different reverse auction mechanisms that are into operational and are illustrated below:

Table 1: Types of Reverse Auctions

S. No.	Type of Auction	Details Description
1	Reverse Auction	Applicable where the sellers compete to obtain business from the buyer and prices will typically decrease from start point as the sellers undercut each other
2	Reverse Dutch Auction	Applicable where buyer raises the price from a low starting point until a bidder agrees to sell at the stated price
3	Reverse Japanese Auction	In this particular type of auction, the price is continually declining at pre-set decrements over pre-set time periods; bidders may choose to agree to the price (opt-in) and stay in the auction, or they drop out. There is no joining after it starts or re-entering after dropping-out. When all of the participants drop out or are timed out, the auction ends and the bidder with the lowest price is the winner

OBJECTIVE

• To show step by step process of implementation of E-procurement on a manufacturing firm and summarizing potential gains.

Approach- Design

We started with an approach to first categorize the purchased items in terms of their criticality. Criticality enables us to define additional attributes that may be required while creating an auction event.

Key enablers of e-Procurement:

✦ Item categorization
✦ Criticality matrix and types of auction to be used against each bucket
✦ Demand aggregation for quantum of supplies
✦ Negotiation Model and Process flow

Items Categorization

The studies and the observations showed that there was no proper classification or categorization of the items being bought. All the items therefore need to be first categorized as per cost and criticality to understand the buying urgency which we should be utilizing to select the appropriate strategy for each type of the items. The criticality definition was done by the User Department and the Purchase Department members on the basis of various criteria.

Table 2: To be Purchased Items Criticality Scoring Index to Determine Criticality of Purchased Item

Criteria for Criticality	1	2	3	4	5	Weightage
Immediate Impact on Production	No	Low	Medium	High	Completely Stopped	35%
Inventory Level in Hand	Very High	Desired	Medium	Low	Very Urgent	22%
Supply Lead Time	1 to 2 Days	7 days to 15 Days	16 days to 60 days	61 days to 119 days	More than 120 Days	17%
Supplier Location	Local	In the same state	In the country	Abroad but in multiple countries	Abroad but only in one country	10%

Past History of Purchase	Frequently Bought	Bought more than once every year	Bought every alternative year	Bought once before	Never Bought	8%
Item Category	Standard (Generic)		Not Standard but with Specs in plant		Non Standard without Specs in the plant	5%
Legal Requirement	No	Low	Medium	High	Very High leading to stoppage	3%

Table 3: To be Purchased Items Cost Scoring Index

	1	2	3	4	5
Cost of item in Rs.	Less than 5000	5000 < X < 50000	50000<X<200000	200000<X< 500000	X > 500000

The criticality scoring and the cost scoring were done for all items. Once the score developed for all items they were put in the buckets as per the Matrix.

Table 4: Sample Item Categorization Table

S. No.	Item Name	Impact on prod.	Req. type	Supply Lead Time	Legal req.	Supp Loc	Past history of purchase	Item Category	Criticality Score	Cost Score	Category
1	A	5	5	2	2	4	2	5	4.0	3	8
2	B	2	4	2	4	2	4	2	2.7	4	3
3	C	3	3	3	3	3	3	3	3.0	3	5
4	D	4	2	4	2	4	2	4	3.3	2	4
5	E	4	4	4	4	4	4	4	4.0	2	7
6	F	1	5	1	5	1	5	1	2.3	1	1
7	G	2	4	2	4	2	4	2	2.7	3	2
8	H	5	5	5	5	5	5	5	5.0	4	9
9	I	4	4	4	4	4	4	3	4.0	4	6

Criticality Matrix

Based on the categorization we developed the Criticality Matrix for all Items and place them in different quadrants. A 3 x 3 matrix was developed for the same purpose which had cost on the X Axis and the Criticality on the Y Axis.

Table 5: Criticality Matrix

COST	HIGH (4.0 - 5.0)	Item 5	Item 1	Item 8
	MEDIUM (3.0 - 3.9)	Item 4	Item 3	Item 9
	LOW (1.0 - 2.9)	Item 6	Item 7	Item 2
		LOW (1.0 - 2.9)	MEDIUM (3.0 - 3.9)	HIGH (4.0 - 5.0)
			CRITICALITY	

As illustrated above, all items were classified under these 9 buckets. This helped to adopt different strategies to buy different items to maximize benefits. It is not possible and economical to buy all items using a same strategy and same channel. The number of Vendors, their location radius and credit/payment policies developed separately for each group.

Also items which were high on criticality or high on value we adopted a strategy to look into for domestic or cheaper substitutes or in-house developments to move them to lower quadrants. The target for both User Departments and Procurement Department should be to bring most items in the lower quadrants and have minimum high value and high critical items to increase efficiency and reduce cost of purchasing.

Table 6: Types of Auction WRT to Criticality of the Item

VALUE	HIGH		Hard & Competitive Bidding		Identify a set of vendors, technically approved by user		Dedicated Vendors with Strategic Partnership
			100% of demand aggregation		Split the entire order among multiple vendors to mitigate risk		100% of demand aggregation
			Zero Based Costing to be done		Zero Based Costing to be done		One on One Off-line Negotiations after proper scrutiny
			Develop as many vendors as possible		At least 4 vendors should be there for each item		Zero Based costing should be done
			Dutch e-Procurement may be done		Dutch e-Procurement may be done		Proper review by PR Review Committee mandatory
	MEDIUM		Standard Reverse English e-Auction Process		Standard Reverse English e-Auction Process		Dutch or English Auction depending on number of Vendors
			Open PO may be given for frequently purchased items		Open PO may be given for frequently purchased items		Advance orders may be given to items with high lead time

		Create long time (Annual, Half Yearly or Quarterly) Open PO to approved vendors		Create long time (Annual, Half Yearly or Quarterly) Open PO to approved vendors		Develop some safety stock in the Plant. Define level of stock dependent on consumption
	LOW	Create ARCs where ever possible		Most items should be procured with-in Raipur/Kolkata/Indore/Bhilai/Vizag		Annual Requirement plan should be sought from User Department & Cross checked with Y-O-Y Buying Pattern
		Most items should be procured Locally if possible		Standard Reverse English e-Auction Process		Advance orders may be given to items with high lead time
		Create as many vendors as possible		Create as many vendors as possible		Standard Reverse Auction but with same Vendor Category
		LOW		MEDIUM		HIGH
				CRITICALITY		

The review of the criticality matrix should be done once every year and the critically scoring of all items should also be reviewed once every year to eliminate redundant or obsolete items and include new machines spares and items as per the change in business requirements. Additionally the frequency of review can be increased if required depending on changes in business environment.

DEMAND AGGREGATION

All user departments should submit their annual requirement of all items depending upon their production plan, shutdown plan and equipment health of the entire year. This should be submitted to the Procurement Department by the first week of March of any given year (for the next financial year). The departments should mention the quantity required and the month of requirement for each item mentioned. The list should be at least 80% accurate. In case of a stand-by requirement or spare unit requirement, it should be categorically mentioned and also should have due approvals from the Purchase Review committee.

Procurement department should aggregate the requirement of the entire plant and check in accordance with the past purchase data.

Procurement department should conduct e-Auction of the entire requirement with staggered delivery option.

Alternatively price catalogue for certain items can be asked from vendors quoting the entire quantity and a forward auction can be done on the discount percentage. This again should be reviewed in the above mentioned frequency depending on the market conditions.

NEGOTIATION MODEL

The negotiation model is shown in Figure1, where a mediator exists in the market. Three attributes (price, quantity and lead time) and Kitems are involved. The attributes of each item are defined as a triple (price, quantity lead time) the price, quantity, and lead time of item of MAi for MSA j). The determinations of the quantity and lead time of MAi depend on the demand of the market, and the demand of the market is affected by the price of items. The mediator or e-procurement model in the responsible for: (a) transmitting the bids of the MAs to the MSAs, and then transmitting the counter-offer from the MSAs to the MAs; (b) determining the final equilibrium of the negotiation between each MA and MSA; and (c) determining the final allocation scheme(Yu et al., 2015).

Figure 1: MAMI Negotiation Model
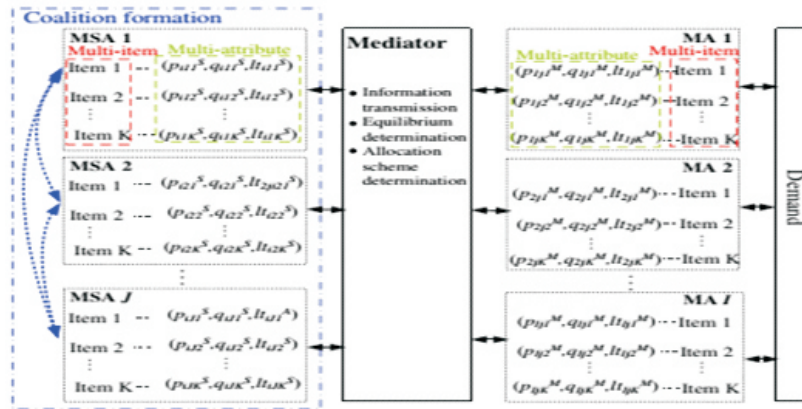
E-Procurement Process flow

Auction process designed in such a way to provide an opportunity to the purchaser to review the auction event before scheduling for actual auction and select the suitable auction model i.e. English, Dutch or Japanese based on items value, criticality and no of supplier availability. i.e., If only one supplier is technically qualified. Hence makes sense to go for Dutch auction. And if higher no of suppliers of equal capability are ready to supply, go for Japanese auction.

In next page there is schematic end to end mapping of indent to PO process. This has been mapped right from requirement generation so as to include every detail which can effect implementation of E- Procurement.

Figure 2: Process Flow of E-Procurement Process
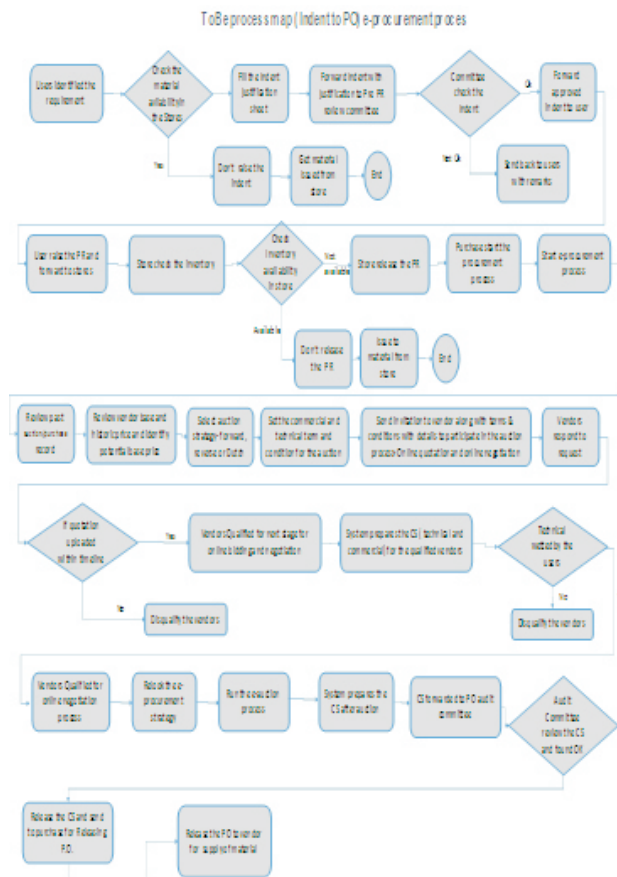
Approach-Implementation
E-Procurement or Reverse Auctions

The e-Procurement system was developed. The step by step guide with Time Line and Business Rules of the same is shown below.

Table 7: Process Steps for E-Procurement

S. No.	Process steps	Timeline	Business Rules
1	Requirement received from Users: - Planned, -Spot,-New	Day-0	1. Requirement to be aggregated to have the clear view of annual demand. 2. Prepare staggered delivery schedule in line with maintenance and production plan 3. Items which have high price fluctuation should not be bought in bulk or developed into an Annual Rate Contract 4. Conduct e-Auction for PR Value more than Rs. 100000
2	If applicable Requirement sent to stores for checking the inventory level	Day-1	1. All inventories should be mapped in the system. 2. Booking/Charge Out should only done once material is consumed by the User Department 3. All material issued should be stock transferred to dynamic store/Plant and then respective department will book the consumption as per actual. 4. Status of items should reflect in the system at all times. 5. Stores shall be authorized to allocate un-used material to other plants if required.
3	Check Inventory availability in the store	Day-1	1. For every PR plant level inventory to be checked at all locations
4	Start e-procurement process	Day-1	
5	Review past auction/purchase record	Day-2	1. Past purchase details: vendor type, price and purchase date to be known to the buyer 2. Buyer should be knowing the rationale of price movement (i.e. cable price movement with copper and aluminium price) and let purchase department know the current suggestive price of the item
6	Review vendor base and historic price and identify potential base price	Day-3	1. Vendors should be categorized based on manufacturer/Trader , supply quality and delivery performance 2. New Vendor should be added to different categories to ensure healthy competition 3. In any item where ever there is less than three vendors, e-Auction should be done only after addition of more qualified vendors. If there are no more vendors, go for a normal auction or reverse Dutch auction

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| 7 | Select auction strategy- English or Dutch or Japanese | Day-3 | 1. Auction strategy should be selected in line with items type and vendors types and nos. |
			2. For catalogue price fixed items (Example: Bearing, Motors, Pumps) effort should be made to find more distributors of the same brand to get better discount
			3. Before conducting the e-Auction, Vendor Type should be selected in consultation with the user department. (Example: for Conveyors MRF, Goodyear, Continental, Phoniex should be grouped together during e-Auction)
8	Set the commercial and technical term and condition for the auction	Day-3	1. All technical and commercial details should be captured in the system itself
			2. Very limited/NIL people should have access to base quotation details before auction
			3. Details like Vendor Names should be masked in all Comparative Sheets (Commercial and Technical) before auction
9	Send invitation to vendor along with terms & conditions with details to participate in the auction process- Online quotation and online negotiation	Day-3	1. Terms and condition should be reviewed for each category based on nature of the items and market conditions before designing the auction event
10	Vendors response to request	Day-6	1. Timeline should be adhered in order to control PR to PO lead time
			2. Extend quotation time only in case of genuine reasons
			3. Vendors not participating in e-Auctions or not co-operating should have a decreased score in vendor evaluation
			4. Category buyer should develop more vendors in such cases
			5. No telephonic calls to and from any vendors should be allowed during the auction event. Vendors can only connect with the buyer via a chat facility. Buyer should not give any indications to the vendor about any price.
11	Vendors Qualified for next stage for online bidding and negotiation (Based on Timely Submission of Quotation)	Day-6	1. In order to ensure the discipline among the vendors, late entry should not be considered
12	System prepares the CS (technical and commercial) for the qualified vendors	Day-6	1. Only system generated CS should be considered for e-auction
			2. Post CS generation from system only masked name and rank of the vendor should be visible to the person running the e-auction

13	Technical wetted by the users	Day-7	1. Technical qualification details should be vetted by the respective department HoD within 24 hours of receiving the Technical Comparative Sheet
14	Vendors Qualified for online negotiation process(Technically Qualified)	Day-8	1. Drop the vendors if technically not qualified (shelf life and running life is not matching with the expectation)
15	Relook the e-procurement strategy	Day-8	1. Based on revised vendor list relook the e-auction strategy
16	Run the e-auction process	Day-9	1. Chat facility should be utilised aggressively to ensure active participation from vendors
17	System prepares the CS after auction	Day-9	1. All data to be securely saved in the system for later use for entire auction base price, final price and increment/ decrement details
18	Compare CS with historic purchase data	Day-9	1. Vendor wise past and current buying details should be captured and stored
19	If L1 quote is Ok, Release P.O. In Next 48 Hours	Day-10	1. No offline negotiations should be happening post L1. 2. Post L1 declaration release the order within stipulated time 3. Post L1 identification auction can be called off against genuine reasons only (i.e. huge difference in unit price of past Vs current purchase, no longer needed for consumption)
20	If L1 is not OK, re run the Process		

FINDINGS AND CONCLUSION

We implemented e-procurement system and observed results for period of three months. Some of the key achievements are as below:

1. We found great amount of reduction in PR to PO lead time. Over three months period 50% reduction in lead time is observed.

Figure 3: PR to PO Lead Time in No. of Days
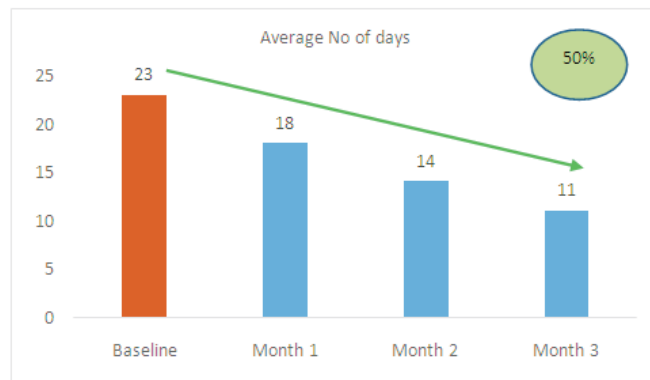
2.In three months we are been able to achieve 9% of cost savings.

Figure 4: Cost Saving Percentage Achieved
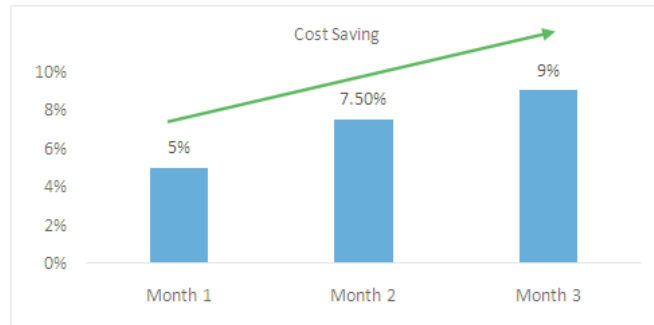
3.Reduction in vendor base, thus decreasing over all supply chain transaction cost.

Figure 5: Reduction in Vendor Base

4.Reduction in inventory from 60 days to 38 days.

Figure 6: Reduction in Inventory Days

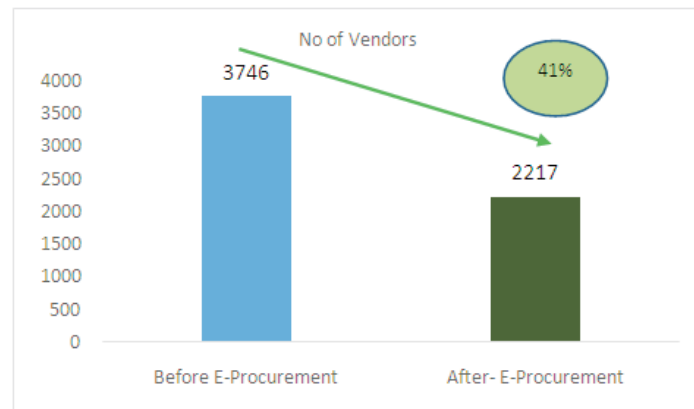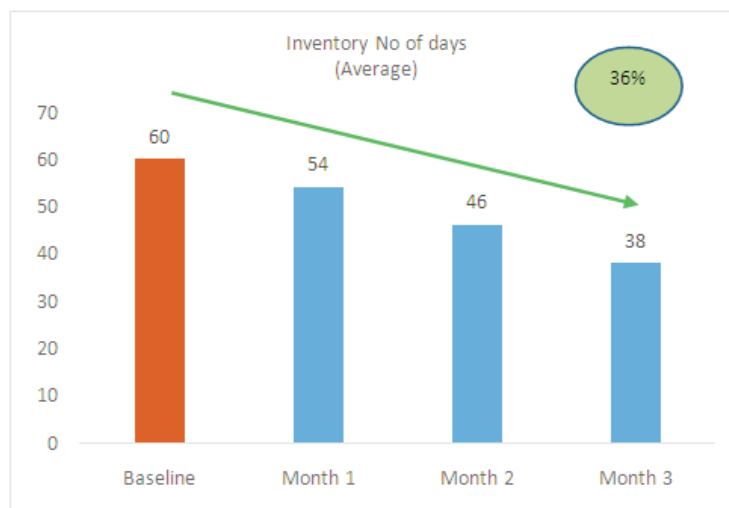## WAYFORWARD

E-Procurement holds a very bright future if implemented with professionals. All suppliers will be encouraged to 'do businesses as the level of transparency increases. Although has been observed that some suppliers, particularly small and medium sized enterprises (SMEs), may have not yet developed the capability to do this.

In addition to supplier capability, cooperation between top management and technology service providers is crucial when implementing systems. Collaboration between buyers, suppliers and support staff is equally important, and users should be approached in a coordinated manner to understand how the system may change their way or working and ease their load.

E-procurement is also a strategic decision, and therefore, a good business design is vital. Above case study revealed, e-procurement is not a technical solution, but an end-to-end business solution. Other key attributes may be factored in while designing system includes:

• Effective procurement policy and practice
• Strategies that enable buyers and suppliers to adopt and use the e-procurement system
• Effective communication program to communicates the value of e-procurement to all concerned
• Well-devised change management program to integrate these diverse parts.

Overall, there are bundle of opportunities for further advancement in e-procurement field.

The modern design of e-procurement is best described as an integrated process that includes different multi attribute, multi item functionality. This will restrict the reverse auction process only to cost.

Moving forward, as e-procurement systems mature and expand, focus can expand to include strategic sourcing decisions which can provide real significant gains.

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