

# Modeling Purchase Benefit and Associated Risk from e-marketplace

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**Abstract:** Due to globalization of business and flourishing of various forms of e-marketplaces, organizations are coming out from the arm-length partnership of supply chain model and rely more on open architecture e-procurement model. If the purchaser depends more and more on e-marketplace, he is entering more and more in the risk zone though he is availing transaction benefit, because probability of getting item from the open market is gradually decreasing as the order-size increased. Hence, there should be some optimal point beyond which procurement through e-marketplace becomes unviable for the organization. This cut-off point has been modeled using average market availability of items ( $\lambda$ ) in Poisson distribution. This model will help the organization to identify the particular cut-off level for e-procurement in a given market situation.

**Key Words:** e-Procurement, e-Marketplace

## 1. Introduction

Wang [Wang, *et al*, 2006] show that IT-enabled virtual integration of supply chain and supplier responsiveness gives flexibility to manufacturer. It will increase the efficiency of supply chain. The Internet has broken the market barriers globally. Due to globalization of business, today's partner may not be a partner for tomorrow. Rita Cardenas [Cardenas, 2002] classified the forms of future B2B model. Flourishing of various forms of Internet-based e-procurement models like *Consortium Exchange*, *Mega Exchange* and *Meta Exchange* [Corsten, *et al*, 2001] and *Solution Provider*, *Specialist Originator*, *Sell Side Asset Exchange* [Cardenas 2002], organizations are coming out from the arm-length

partnership of supply chain model and rely more on open architecture e-procurement model. Due to close bonding relationship between arm-length partnerships in supply chain, there was little scope for negotiated price. During procurement of goods or services, the major chunk of the procurement has been made through known channel partners (close B2B model) and the rest kept for open seller site/e-marketplace like [www.SeekandSearch.com](http://www.SeekandSearch.com). It will give an organization a more flexible way to manage its e-procurement policy. This flexible part will help the organization to achieve better productivity in adverse conditions. Now, the question will arise, what will be the best composition between the close B2B and open marketplace? It would be a debatable issue. Decrease in close B2B contract and reliance on e-marketplace means that organizations are entering into a more volatile zone. It will increase the positive risk factor for smooth supply at higher demand. But at the same time, organizations are gaining some competitive price advantage from e-marketplace as well as gaining some negative risk factor at lower demand condition. Purchase through e-marketplace like [www.SeekandSearch.com](http://www.SeekandSearch.com) and auction house like [www.eBay.in](http://www.eBay.in), where availability and price are dynamically changing and are operated on an ask-bid system could not guarantee the supply of items. In this paper, a model is propose which will help the organizations for better planning of their purchasing system and reduce the risk factor of e-procurement.

## **2. Issues related to e-Procurement**

If a manufacturer has a yearly contract with a specific vendor for supply of raw material then there will be some supply chain benefits of that agreement. Few of them have been listed below.

- It assures timely supply of raw material to the manufacturer
- It helps the vendor (raw material supplier) in better planning

At the same time, there are disadvantage in the supply chain related to efficiency. These have been listed below.

- It may not be the best deal for manufacturer i.e. *Opportunistic Vendor*
- Manufacturer can not avail the *Transaction Cost Benefit* from e-marketplace
- Manufacturer can not gain from demand variation vis-à-vis variation of production

There are many models relating to supplier-buyer contracting to optimize channel benefit. Ha [Ha 2001] refers to the optimal cut off level of supply when marginal cost of buyer is known for better supplier benefit. Corbett [Corbett, *et al*, 2000] modeled optimal quantity discount policy under asymmetric information. But our problem is different. Our objective is to reduce the channel dependency. Its ultimate aim is the elimination of entire dependency among the supply chain partners.

### **3. Methodology**

Firstly, we want to model the gradual elimination of vendor contract and measure the actual benefit. As the buyer more and more relies on a flexible open market, the buyer enters into a graver risk zone. In the second step, we want to explore how the risk factor can be reduced in the open market architecture using modern web-based technology.

The manufacturer can gain from the open market situation as well as variation of production if he has a partial (less than average demand) supply contract with the vendor. Bakos [Bakos 1991] analysis of *Electronic Marketplace* shows that prices, seller profits and buyer welfare will have a direct relationship with economic theory. It shows that buyer's welfare will increase in electronic marketplace because of availability of products and price information through intermediaries. It is an established fact that always there is transaction cost benefit of purchase through e-marketplace. Component of *Transaction Cost Benefit* in e-marketplace is not our focus in this paper. If the manufacturer depends more and more on e-marketplace, he is entering more and more in the risk zone though he is availing transaction benefit, because probability of getting item from the open market is gradually decreasing as the order increased. Hence, there should be some optimal point beyond which procurement through e-marketplace becomes unviable for the organization. This optimal point may vary depending on current market availability

and demand. In the following experiment, an attempt has been made to model cut-off risk from e-procurement. In this paper, we are trying to develop an open market architecture where customer can avail an end-to-end service independently i.e., there will be no close relationship or dependable consignment between buyers and sellers.

#### 4. e-Procurement Model from Open Market

As e-marketplace is a sub-set of the global market, where many buyers and sellers are participating, its behavioural characteristic can be assumed as a Poisson distribution of mean item availability irrespective of the global market, which may behave as normal distribution. The probability of not getting the required quantity will reduce the actual benefit. Therefore, it will gradually reduce the actual benefit from the open market situation. Suppose, the maximum requirement of items to be purchased through e-procurement is 10.

Let the benefit of  $i^{\text{th}}$  item purchased through e-market follow the equation

$$b(i) = mi \text{ where } i = 1, 2, 3, \dots \text{ ----(1)}$$

The slope of the line  $m$  indicates that the buyer will get more benefited when more items are purchased from the open market.

Total benefit will be  $\mathbf{tb}(\mathbf{n}) = \sum_{i=1}^n b(i)$  where the probability of getting each item = 1.

Benefit of purchase of  $n$  item from e-market when there is some probability of getting an item will be

$$\mathbf{Etb}(\mathbf{n}) = \sum_{i=1}^n P(N = i)b(i) \text{ ----(2)}$$

Ideal benefit for a particular purchase composition can be calculated based on summation formulae (1). If all the purchases are made through the contract vendor, the ideal benefit is zero, whereas if 100% item i.e., in the above example, 10 items purchased through e-marketplace, the ideal benefit will be maximum. In other compositions of purchase, the ideal benefit will lie between the two extreme values.

Let the value of  $m$  be  $1/10$ , then it will restrict the maximum benefit to 1 for  $10^{\text{th}}$  items purchased from e-marketplace. The following table (Tab: 1) shows the item-wise ideal benefit of e-procurement where probability of getting an item has been taken 1.

Item(i)	$b(i) = mi$	$\sum_{i=1}^n b(i)$
1	1/10	0.1
2	2/10	0.3
3	3/10	0.6
4	4/10	1.0
5	5/10	1.5
<b>6</b>	6/10	<b>2.1</b>
7	7/10	2.8
<b>8</b>	8/10	<b>3.6</b>
9	9/10	4.5
10	10/10	5.5

Tab: 1: *Ideal benefit of e-procurement*

Let  $\lambda =$  mean availability of item in a section of market (sub-set of global market). In equation (1), let  $m = 1/10$ . We have calculated the probability of getting items in the market for two values of  $\lambda$  i.e.,  $\lambda = 8$  and  $\lambda=10$ .

As e-marketplace has been assumed to behave like a *Poisson* process, the probability of getting item will decrease with increase in item numbers. If we want to purchase 2 items and 5 items from e-marketplace having mean availability of 8 items, the probability of getting 2 items is more than that of getting 5 items. Hence, there is a risk factor associated with e-marketplace, which will reduce the ideal benefit i.e., actual benefit will be less than the ideal benefit in each condition. Now we try to calculate the actual benefit of purchasing from e-marketplace.

Here, we consider the probability of getting items from e-marketplace i.e.,  $P(N)$ . Let  $\lambda =$  mean availability of item in a market and  $i$  be the number of item(s) to be purchase from open market Then the probability of getting  $n$  items  $P(N=i)$  will be

$$P(N=i) = \frac{\lambda^i e^{-\lambda}}{i!} \quad \text{----(3)}$$

The actual benefit of purchase of  $n$  item from e-market will be

$$\sum_{i=1}^n P(N=i)b(i) \quad \text{----(4)}$$

$$\Rightarrow \sum_{i=1}^n \frac{\lambda^i e^{-\lambda}}{i!} b(i) \quad \text{----(5)}$$

Based on the above formulae (5), we calculated the actual benefit on two market conditions i.e.,  $\lambda = 8$  and  $\lambda = 10$ , and tabulated these below (Tab: 2).

Quantity Purchase from e-Market(i)	$\lambda = 8$			$\lambda = 10$		
	$P(N=i)$	$P(N=i)b(i)$	$\sum_{i=1}^n P(N=i)b(i)$	$P(N=i)$	$P(N=i)b(i)$	$\sum_{i=1}^n P(N=i)b(i)$
1	0.9997	0.09997	0.09997	1.0	0.1	0.1
2	0.996	0.1992	0.2989	0.9995	0.1999	0.2999
3	0.9862	0.29586	0.59476	0.9972	0.29916	0.59906
4	0.9576	0.38303	0.97779	0.9897	0.39558	0.99464
5	0.9004	0.4502	1.42799	0.9707	0.48535	1.47999
6	0.8088	0.48528	<b>1.91327</b>	0.9329	0.55974	2.03973
7	0.6866	0.48062	2.39389	0.8699	0.60893	2.64866
8	0.547	0.4376	2.83149	0.7798	0.62384	<b>3.2725</b>
9	0.4075	0.36675	3.19824	0.6672	0.60048	3.87298
10	0.2834	0.2834	<b>3.48164</b>	0.4479	0.4419	<b>4.31488</b>

Tab: 2: Actual benefit of  $n$  item from e-procurement

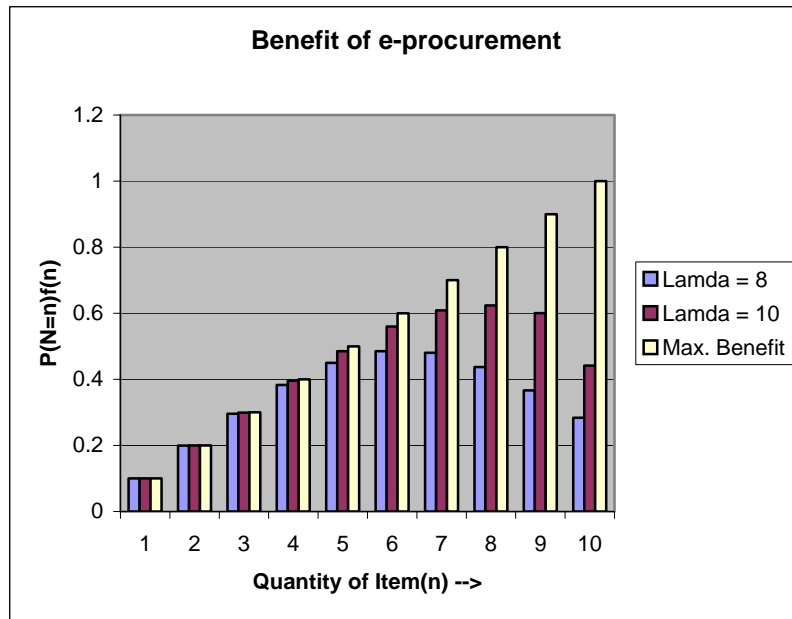


Fig: 1: Purchase Benefit and Risk factor from e-marketplace

**Results & Discussion:** Probability of getting items will increase with the increase in the value of  $\lambda$ . At zero item purchase from the open market, maximum benefit is zero. When entire items purchased from e-marketplace, the ideal benefit is maximum and it is 5.5.

## 5. Risk of e-Procurement from e-marketplace

**Risk Factor & Cut-off Point:** In this experiment, it has been shown that increase in  $\lambda$  will increase the actual benefit of purchase from e-marketplace. But what should be the ideal cut-off point where organization will balance optimal benefit and associated risk? The actual benefit of the above example has been tabulated below based on two values of  $\lambda$ .

From the above graph (Fig: 1), it is clear that at  $\lambda = 8$ , difference of ideal benefit from actual benefit is widening at a faster rate after  $i = 6$ . So, it is better to purchase a maximum of 6 items from e-marketplace. Similarly, at  $\lambda = 10$ , the gap is widening at a faster rate after  $i = 8$ . So, it is advisable to purchase a maximum of 8 items from e-marketplace in this situation. Therefore, the cut-off condition will be as follows.

$$P(N=i) b(i) > P(N=n-1) b(i-1)$$

That is, till actual benefit of  $i^{\text{th}}$  item is greater than its previous item i.e.,  $(i-1)^{\text{th}}$ . Actual accumulated benefit on those two conditions has been tabulated below.

	<b>Ideal Benefit</b>	<b>Actual Benefit</b>	<b>Cut-off point (n)</b>
$\lambda = 8$	2.1	<b>1.91327</b>	6
$\lambda = 10$	3.6	<b>3.27250</b>	8

Tab: 3: Actual benefit of e-procurement at cut-off point

**Remarks:** From the above results, we can draw the following conclusion.

- Cut-off point is increasing with  $\lambda$  i.e., higher the value of  $\lambda$ , **the** more items can be purchased from the e-marketplace
- Actual benefit is increased with the increase of  $\lambda$

In this model it is assumed that *Transaction Cost Benefit* from e-marketplace over *Opportunistic Vendor Deal* is linear in nature. But it may be the in-step function where bulk discount policy is adopted by vendor or may be in some other function. In those cases, the absolute benefit line may not be a straight line. If we know the slope of the e-procurement line of a particular organization for a particular item and mean availability of that item in e-marketplace, we can easily calculate the cut-off point of e-procurement for that item.

## 6. Conclusion

In this paper, a risk and benefit model has been proposed. This model will help the organization in e-procurement system. This model will be able to identify the actual benefit of a particular level of purchase from the open market and associated risk factors. Using this model, an organization can identify the particular cut-off level for e-procurement in a given market situation.

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