

## **P<sup>3</sup> System- A study of effectiveness of the system in real life situations through study of customer satisfaction levels.**

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**Abstract:** In this note, in connection with and continuity of our published and successfully implemented work on P<sup>3</sup> system, we reveal the aftermath of our strong impression that we carried over a long period of time and that deeply concerned about the systematic study of customers level of satisfaction after adoption of P<sup>3</sup> system over the different system they previously adopted and implemented over a long period of time dealing in highly sensible and critical business of dealing with in life-saving medicines. On giving a note depicting salient features of P<sup>3</sup> system we have carried over to significant testing on satisfaction level as a parameter which is well defined and implemented commonly to all the buyers on list. Concluding results establishes what we previously conceived of as principle tenets in fundamental and defining structure of P<sup>3</sup> system.

**(1) Abbreviations\*, Notations, and Key words:**

**Abbreviations:** P<sup>3</sup> System- Production, Planning and Procurement System

SI: Satisfaction Index (Customers' level of Satisfaction towards Working with P<sup>3</sup> System)

**Notations:** H<sub>0</sub>: Null Hypothesis, H<sub>1</sub>: Alternate Hypothesis, α = Level of Significance

**Key Words:** Safety Stock, Emergency Stock, P<sup>3</sup> System, Satisfaction Index and Classes, Paired T test.

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### **(2) Assumptions and Fact:**

- a) Distributors and buyers can freely exchange information on markets trends, status of the present stock, future projections, and financial matter related to their business with the vendor.
- b) Maintenance and replenishment of a reasonable stock level at buyers' and distributor's ends are important commitment of the vendor
- c) Except for as an aftermath of erratic event, demand for the supply of new stock at different period of time remains within the close range of average annual demand of all buyers.

#### **Facts:**

1 Continuous and timely supply without shortage at any point of time in a cycle is one of the important factor that has a dominating role determining customer satisfaction.

2 There is an inverse relation between shortage and customer satisfaction level.

## **I. Introduction**

### **1.1 P<sup>3</sup> System- At a Glance**

P<sup>3</sup> system as designed has its roots strongly grounded on the study of many known and presently in operations, various distribution channels. The origin of the P<sup>3</sup> system lies in the fundamental need to avoid shortages and run the 'Life Saving Medicine' supply uninterrupted. So it was planned and previously design to have three to four- tier supply chain. Again care was properly taken to see that

(a) Transportation cost should not increase crossing a pre- decided and fixed cost line but in extra ordinary cases vendor, in spite of bearing a loss, may do so keeping 'no shortage' principle in view. Chances of occurrence of such events are very slim but probability of occurrence cannot be refuted A vendor truly dedicated to business ethics and focused to maintenance of goodwill shall never hesitate to bear with such occasional but liability induced cost. Yes, but he will be careful and will redesign the distribution system to see that such incidences, if at all are likely to occur, should give early alarms from the market movements so timely steps can be planned to meet with consequences that may arise from time to time.

(b) Customers are given a good discount on the amount of safety stock they receive along with their order fulfilled as per the normalized stock amount adjusted in accordance to order size. This is sufficient enough to meet with holding cost of additional or safety stock amount well received along with regular stock.

(c) Reports of data analysis of market survey carried out by analyst are immediately shared with all buyers on list and the vendor plans his operations to meet with fluctuating demand to see that under stocking or over stocking in excess to normal limit should not happen in critical situations.

The P<sup>3</sup> system provides a multi-tier stock management at vendor's level, distributor (intermediate) level and point of sale (buyer) level in order to avoid "out-of-stock" situation in cases for the buyers dealing with essential life saving medicines. These stocks are termed as

1. Safety Stock
2. Emergency Stock
3. Lightning Stock
4. Residual Stock

In P<sup>3</sup> system, as designed, the stocks mentioned in 3 and 4 above are totally within control of the vendor and he controls its operations. These stocks are, may be referred to as 'reserve stock' and on vendor's discretion may, fully or partly, be diverted to a few buyers. Some times some buyers have some additional advantages as their service centers or medical stores might be in vicinity of big multi- specialty hospitals or some emergency medical centers. Such buyers are on special and prompt attention list and draw special attention.

Sharing of lightning stock and residual stock, doubtlessly is a privilege and equal right to all the buyers but it is mostly, as observed by experience, in most cases are diverted to such buyers on critical list. On the top of this, any amount left surplus from this stocks is diverted to the production of current batch and it is on the lot of the first distribution. This is with an only intension that the expiration date of the lot period is fairly maintained.

(d) Several papers, in principles and ideals, have already been published and has been implemented to assess its feasibility and carry out diagnostics to study

(1) aftermath of the impact on system when it actually faces problems of real life situation.

The study mainly focused on assessing efficiency of the P<sup>3</sup> system to avoid the stock-out situation.

(2) What are the reactions of buyers and their level of satisfaction

The studies revealed encouraging results and edge of P<sup>3</sup> systems over existing systems of inventory management. It was also suggested to test the effectiveness of the novel P<sup>3</sup> system and to study whether the system indeed brought any benefits to the buyers.

It was therefore decided to conduct a statistical study to check the customer satisfaction level and evaluate whether the adoption of P<sup>3</sup> system brought any improvement in inventory management – Planning, production, and procurement set-up from both the vendor's and buyers' point of view.

## **II. Customer satisfaction level**

In order to measure customers' satisfaction level a survey involving different parameters associated with supply chain, delivery schedule, demand pattern etc. was conducted by the manufacturer and the results revealed that satisfaction level, depending upon past experience, varied from buyer to buyer.

It was, as a result, concluded that the satisfaction index, denoted as SI, falls in the range of different class levels.

- (1) Class 1: [0, 0.15] then it indicates poor satisfaction
- (2) Class 2: [0.16, 0.50] then an average level
- (3) Class 3: [0.51, 0.85] then a fair level
- (4) Class 4: [0.86, 0.99] then best and highly promoting.

The aim was to understand the efficacy of inventory management systems, the therefore shortage was considered as an important parameter to monitor and to arrive at the customer satisfaction.

The customer satisfaction was denoted as SI which is the Satisfaction Index.

We define SI as follows.

$SI = \text{No. of times delivery scheduled is maintained} / \text{Total number of delivery schedules}$

This ratio can be improved upon to utmost satisfactory level if number of cases not meeting with delivery date are monitored and controlled. The higher the SI index the stronger the customers' satisfaction level. In turn, higher satisfaction level indicates sound and steady business. On the contrary, satisfaction index of customers or buyers falling in the range of class 2 or class 1 indicates proper attention to be paid or else they are likely to switch over to promote for some other companies dealing in the same type of business and which assures him for replenishment on or before the target date as committed or agreed upon as the contract may be.

Aftermath of this probable event of switching over, its financial impacts to the manufacturer and its market team may be very little but market impacts in terms of long standing impacts like goodwill, branding, and integrity are long lasting and becomes ‘quotes’ in a region where a few buyers are dealing in life saving medicines –an important pillar in medicinal market.

**(3) A record of inventory cycles for a buyer.**

Interval (in Days) showing arrival of new stock [40, 45] inclusive.

Demand is a random but normally expected to remain within 10% of expected days the stock should last

Ordering Cycle No.	Size of Order Placed	Actual Receipts	Expected Average Demand /Day	Expected No. of days Stock Lasts	Actual No. of Days Stock Last	Arrival of New Stock After Previous Order	Status Shortage Days	Status Extra stock Days
1	200	210	5	42	41	40	0	1
2	210	210	5	42	42	43	1	
3	220	220	5	44	41	42	1	
4	205	205	5	41	40	42	2	
5	205	205	5	41	41	41	0	
6	205	210	5	42	40	43	3	
7	205	205	5	41	40	42	2	
8	225	220	5	44	43	44	1	
9	220	220	5	44	44	44	0	
10	220	215	5	43	42	44	2	
11	220	220	5	44	41	42	1	

**Table 1: Inventory cycle of a buyer preceding the implementation of P<sup>3</sup> system**

Shortage in Days (x <sub>i</sub> )	Frequency f(x <sub>i</sub> )	P(X <sub>i</sub> )	X <sub>i</sub> · P(x <sub>i</sub> )
0	3	3/11	00
1	4	4/11	4/11
2	3	3/11	6/11
3	1	1/11	3/11

**Table 2: Incidences of shortage for a buyer based on Table 1**

Expected shortage in Days /cycle = 13/11

This indicates that in 11 cycles a total of 8 cycles are such that there were instances of shortage for 13 days at buyers’ end which may be attributed one or more of the following causes.

- (1) At Factory / Production Level: Delayed receipt of raw material, Delayed production, and delay in forwarding
- (2) Logistic Level: Delay in Transition
- (3) Distribution Level: Delay in delivery to be made to buyers

In the above case, there are 3 cycles in a set of 11 cycles such that delivery schedule is maintained according to the given target.

Therefore SI = 3/11 = 0.27 which falls in class 2 showing an average level of satisfaction

Ordering Cycle No.	Size of Order Placed	Actual Receipts + safety Stock *	Average Demand /Day	Expected No. of days Stock Lasts	Stock carried forward / Total Days	Actual No. of Days Stock Last	Emergency stock received from distributor in days	Lightening stock from vendor	Arrival of New Stock After Previous Order	Status Shortage Days	Status Extra stock Days
1	200	210+21	5	46	----/46	42	----	----	40	0	2
2	200	190+20	5	42	2 / 44	42	2	----	43	0	1
3	200	200+20	5	44	1/45	41	2	2	44	0	1
4	200	187+18	5	41	1/42	40	2	----	42	0	0
5	200	187+18	5	41	0/41	41	----	----	41	0	0
6	195	190+20	5	42	0/42	37	2	2	42	1**	---
7	195	187+18	5	41	0/41-	40	2	-----	42	0	1
8	200	200+20	5	44	1/45	43	2	----	44	0	1
9	200	200+20	5	44	1/45	44	2	----	45	0	1
10	200	196+19	5	43	1/44	42	2	----	44	0	---
11	200	200+20	5	44	0/44	41	2	2	44	0	---

**Table 3: Inventory cycle of a buyer after the implementation of P<sup>3</sup> system**

\*According to P<sup>3</sup> system, all buyers receive safety stock, at pre-fixed discount rate, along with the receipt of normalized order quantity calculated in accordance to the order quantity.

\*\* One day shortage in the sixth cycle

Customer's satisfaction index = No. of cycles without shortage/ Total no. of cycles = 10/11  
 SI = 0.90

According to the classification of satisfaction level 0.90 falls in class 4; this indicates a very high grade satisfaction level. In such cases customers /buyers are highly motivated and inspired to promote their sales.

### III. Setting up of Hypothesis and testing:

Markets surveyors studying different upheavals are interested to assess whether switching from the current system of tie-up with the vendor to the newly emerging P<sup>3</sup> system is really beneficial in terms of customers satisfaction level. Aided by a statistician the data of customer satisfaction was collected as given above and apply test to verify their hypothesis.

**Null Hypothesis H<sub>0</sub>** : That there is no difference in the satisfaction level before adoption and after adoption of P<sup>3</sup> system.

**Alternative Hypothesis: H<sub>1</sub>**: After adoption of P<sup>3</sup> system satisfaction level has increased.  
 Level of Significance: 0.05 =  $\alpha$

The data collected on 12 buyers based on the system shown in point no (5) above is summarized as follows: We have 12 buyers on the list who were switched to P<sup>3</sup> system from their earlier system. The following table shows measures of satisfaction level before adopting P<sup>3</sup> system and after adopting P<sup>3</sup> system

Sr. No.	Before Adoption	After Adoption
1	0.27	0.90
5	0.42	0.85
6	0.70	0.80
4	0.75	0.90
5	0.80	0.95
6	0.75	0.80
7	0.75	0.75
8	0.85	0.80
9	0.75	0.95
10	0.85	0.90
11	0.90	0.92
12	0.85	0.95

**Table 4: Table showing Satisfaction Level**

The above data was statistically evaluated on a paired t-test as follows

Sr. No.	Before Adoption = SI <sub>1</sub>	After Adoption = SI <sub>2</sub>	SI <sub>2</sub> -SI <sub>1</sub> = d	d <sup>2</sup>
1	0.27	0.90	0.63	0.6939
5	0.42	0.85	0.43	0.1849
6	0.70	0.80	0.10	0.01
4	0.75	0.90	0.15	0.0225
5	0.80	0.95	0.15	0.02250
6	0.75	0.80	0.05	0.0025
7	0.75	0.75	00	00
8	0.85	0.80	-0.05	0.0025
9	0.75	0.95	0.20	0.04
10	0.85	0.90	0.05	0.0025
11	0.90	0.92	0.02	0.004
12	0.85	0.95	0.10	0.01

**Table 5: Statistical evaluation of Satisfaction Level**

$$\sum d = 1.83 \quad \bar{d} = 1.83/12 = 0.1525$$

$$\sum d^2 = 1.0328 \quad S^2 = \{ 1.0328/12 - (0.1525)^2 \} = 0.0628$$

$$S^2/(n-1) = 0.00571$$

We apply 't' test;  $t = \frac{\bar{d}}{\left(\frac{s^2}{n-1}\right)^{1/2}}$

$$t = 0.1525 / (0.00571)^{1/2} = 2.018$$

#### IV. Discussion and conclusion

A study of 12 buyers who migrated from their existing systems of inventory management to the P<sup>3</sup> system showed changes in customer satisfaction level, reflected by Satisfaction Index as per Table 4. The table shows the Satisfaction level before adoption and that after the adoption of the P<sup>3</sup> system. The data was computed to calculation of t value as per the paired t-test.

#### Conclusion:

Table value for one sided table at 11 degree of freedom at 0.05 level of significance = 1.80. Calculated value is greater than the table value and hence calculated value of 't' falls in rejection region. We reject the null hypothesis and accept the alternate hypothesis H<sub>1</sub>.

H<sub>1</sub>: After adoption of P<sup>3</sup> system satisfaction level has increased.

#### Concluding Remarks:

P<sup>3</sup>system, Planning, Production, and procurement system as designed, is, as tested and verified in cases of extreme severities, an invincible option to all its parallels and capable enough to withstand all extremes in various situations that may arise from time to time. It, to the most, fills nearly all gaps that are directly visible and unforeseen too.

**Vision:** We, the designer of the system, after bagging all primary experiences of multi- dimensional area in the concerned field, aspire to raise it and broader wings in order that it proves its sustainability and contributes a one step advance leap.

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