

# Reinforcing the Performance of P<sup>3R</sup> System in Real Life Situations using Customer Satisfaction Index

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**Abstract**— The ultimate purpose of the operations management is support sustainable business growth. In pharmaceuticals, availability, affordability and accessibility of quality medicines are key necessities for this. This can be effectively achieved, in case of pharmaceuticals and similar products, by ensuring the availability of right quality of products, in right quantities, at the customer's end. Efficient Operations management in pharmaceutical industry is the key to efficient supply chain. These efficiencies can be measured by measuring the customer satisfaction index.

P<sup>3R</sup> has been established as a revised form of the novel P<sup>3</sup> system, which specifically addresses these issues by focusing on Production, Planning and Procurement, and fortifying the operations through track teams. This paper evaluates the performance of P<sup>3R</sup> system operations, by focusing on customer satisfaction index.

**Keywords**— P<sup>3</sup> system, P<sup>3R</sup> system, Operations Management, Pharmaceutical Inventory Management, Track Teams, and Satisfaction Index and Classes, Paired t test

**Abbreviations and Notations:** The following are the abbreviations and notations most frequently used in this article:

**Abbreviations:** SI: Satisfaction Index (Customers' level of Satisfaction towards Working with P<sup>3R</sup> System), VMI: Vendor Managed Inventory, CPFR: Collaborative planning, forecasting, and replenishment, and JIT: Just In Time

**Notations:** P<sup>3</sup> System: As designed, Planning, Production, and Procurement System, P<sup>3R</sup>System: Revised P<sup>3</sup> system, H<sub>0</sub>: Null Hypothesis, H<sub>1</sub>: Alternate Hypothesis,  $\alpha$  = Level of Significance

## I. INTRODUCTION

P<sup>3R</sup> system is refined inventory management tool based on market driven dynamic integration of operations with three key aspects of SCM- Production, Planning and Procurement. It was based on study to update the P<sup>3</sup> system in line with recent developments. Market study was done to have overview and comparison of the various aspects of business. It rests on (1) **Bias free reflexive model and (2) Track Team.**

**Bias free reflexive model** is executed by a team of four to five members and constitutionally two members are from patron customers and the rest are, one from each zone,-- Planning, Production, and Procurement.

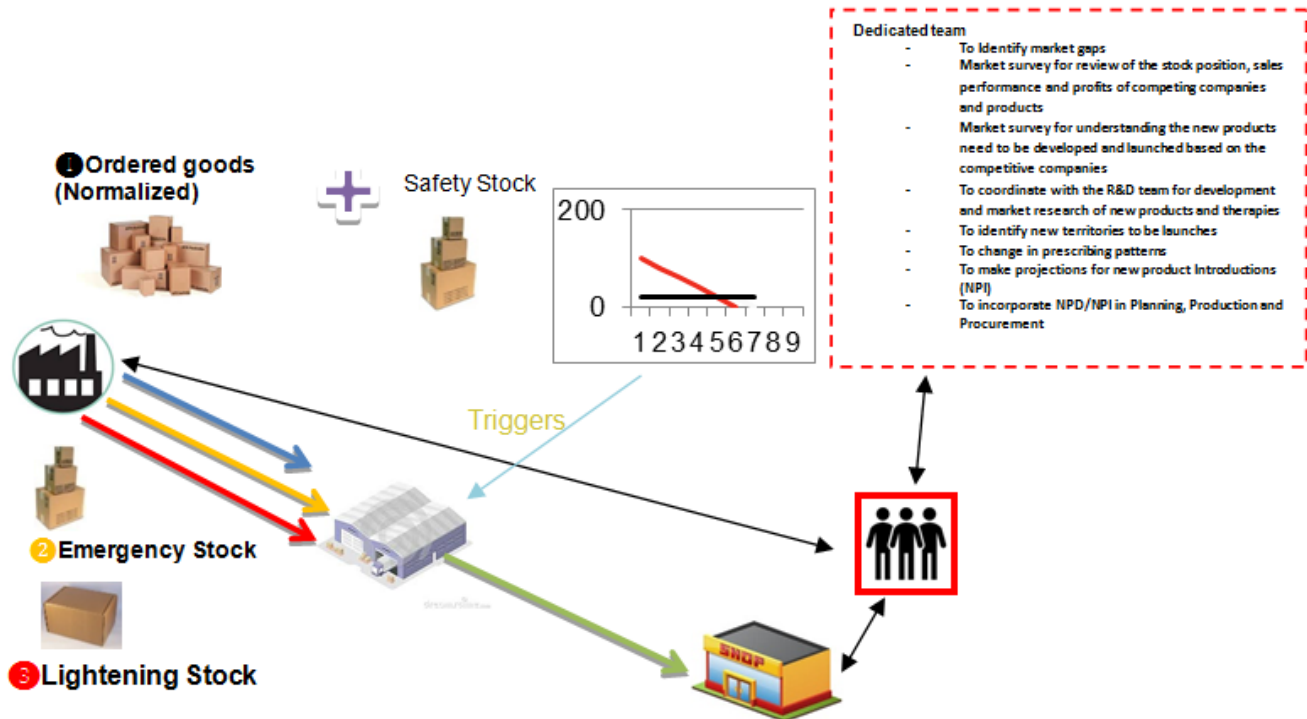
**Track Team** is based on a technical & marketing groups

of people which are devoted to (1) research and development of new drugs which are superior to the regular ones in all respects (2) Keeping analytical track of drugs manufactured by leader pharma companies and (3) New avenues and scopes which can be availed and (4) Market survey for review of the stock position, sales performance and profits of competing companies and products.

A study on our preliminary experiences of P<sup>3R</sup> was done and published in my paper "Time travels---We Revise What We Justified Once" and has clearly shown that the operations management through P<sup>3R</sup> have distinct advantages over the operations through P<sup>3</sup> system.

Subsequent to the success of P<sup>3R</sup>, we decided to track the experiences of more and more users with the revised system, in order to understand the system better and to reassure the efficiency of the P<sup>3R</sup>.

This new version of the P<sup>3</sup> system has additional upgrades over the earlier version. The P<sup>3R</sup> has two additional dimensions. The first dimension is a period review of the market in order to understand the new therapies or products that are needed to be introduced, and the second dimension is the system of handling planning, procurement and production of the new products in the introductory phase, when the history is not available for evaluation of the statistical levels of safety, emergency and lightening stocks.



**Fig. 1.1: An overview of P<sup>3R</sup> system**

The version, P<sup>3R</sup>, offers an excellent upgrade for the existing users of P<sup>3</sup> system. It also offers a striking advantage to the non-P<sup>3</sup> users and offers one more reason to move to P<sup>3</sup>.

## II. CUSTOMER SATISFACTION THROUGH P<sup>3R</sup> DRIVEN OPERATIONS

### 2.1 Satisfaction Index

Customer is the centre of every business endeavour. The ultimate route to a sustainable business runs through satisfied customers. Customer Satisfaction Index was used by Dr. Viranchi Shah and Dr. Pradeep Jha while developing and validating the success of P<sup>3</sup> system. Satisfaction of customer is of profound importance in management decisions, and also the central focus for the enterprises that strive for customer acquisition, satisfaction and retention. Dr. Pradeep Jha and Dr. Viranchi Shah, during the genesis of the P<sup>3</sup> system, demonstrated through the customer satisfaction, by statistical modelling using hypothesis testing, that those in pharmaceutical industries, who handled products where optimised availability was very important, and of them, those who adopted P<sup>3</sup> had significantly higher customer satisfaction level than those who depended on other systems.

In order to evaluate the revision of P<sup>3</sup> system, namely the P<sup>3R</sup> system, a similar principle was adopted. We have used

the same parameters, and ranges as were designed by Dr Jha and Dr Shah.

The satisfaction index, denoted as SI, is classified as follows:

- (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 P<sup>3R</sup> has already been established as effective in real life situation, though evaluation of Moving Annual Turnover. In order to further fortify our findings through an approach that was originally used by founders of P<sup>3</sup> system, we made additional effort of challenging the system through same filters that were adopted by its founders- Satisfaction Index.

SI = No. of times delivery scheduled is maintained / Total number of delivery schedules

Any operation cycles where the delivery date is not maintained is captured as to a failure to satisfy the customer. The higher the index, the stronger is the satisfaction of customer, and the stronger is the possibility of retaining the customers. It also means that the brand is live, there are no replacements of our brands by the healthcare professions- doctors and hospitals. This further translates into successful and sustainable branding.

**2.2 Study of shortages and inventory cycles**

Cycle No	Size of Order Placed in cartons	Opening stock	Actual supplies in cartons	Total Stock	Expected Average Demand /Day	Expected No. of days Stock Lasts	Actual No. of Days Stock Last	Arrival of New Stock After Previous Order	Status	Status	Closing stock on new supply date
									Shortage	Extra stock	
									Days	Days	
1	960	10	980	990	30	33.00	34	31		3	90
2	960	90	980	1070	30	35.67	30	28		2	60
3	960	60	990	1050	34	30.88	31	33	2		68
4	960	0	940	940	35	26.86	30	29		1	35
5	960	35	990	1025	34	30.15	30	33	3		0
6	960	0	1000	1000	33	30.30	30	31	1		0
7	960	0	960	960	30	32.00	34	33		1	30
8	960	30	960	990	34	29.12	30	29		1	34
9	960	34	960	994	32	31.06	30	30		0	0
10	960	0	980	980	30	32.67	32	31		1	30
11	960	30	960	990	31	31.94	34	34		0	0
12	960	0	960	960	31	30.97	30	30		0	0

**Table 2.1: Inventory cycle of a buyer preceding the implementation of P<sup>3R</sup> system**

Shortage in Days ( $x_i$ )	Frequency $f(x_i)$	$P(X_i)$	$X_i \cdot P(x_i)$
0	9	10/12	00
1	1	1/12	1/12
2	1	1/12	3/12
3	1	1/12	6/12

**Table 2.2: Incidences of shortages based on Table 2.1**

Expected shortage in Days /cycle = 6 days /12 cycles

This indicates that in 12 cycles a total of 3 cycles are such that there were instances of shortage for 6 days at buyers' end which may be attributed one or more of the following causes.

- (1) 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 12 cycles such that delivery schedule is maintained according to the given target.

Therefore  $SI = 9/12 = 0.75$  which falls in class 3 showing a fair level of satisfaction.

Cycle No	Size of Order Placed in cartons	Opening stock	Actual supplies in cartons	Total Stock	Expected Average Demand /Day	Expected No. of days Stock Lasts	Actual No. of Days Stock Last	Arrival of New Stock After Previous Order	Status	Status	Closing stock on new supply date
									Shortage	Extra stock	
									Days	Days	
1	1000	5	980	985	30	32.83	34	31		3	90
2	1000	90	1020	1110	30	37	30	28		2	60
3	1000	60	1010	1070	34	31.47	31	30		1	34
4	1020	34	1005	1039	35	29.68	30	29		1	35

5	1000	35	1015	1050	34	30.88	30	33	1	0
6	1050	0	1020	1020	33	30.90	31	31		0
7	1050	0	980	980	30	32.66	34	33		1
8	1100	30	995	1025	34	30.14	30	29		1
9	1000	34	960	994	32	31.06	30	30		0
10	980	0	990	990	30	33	32	31		1
11	990	30	1020	1050	31	33.87	34	34		0
12	990	0	1005	1005	31	32.41	30	30		0

**Table 2.3: Inventory cycle of a buyer after the implementation of P<sup>3R</sup> system**

Customer's satisfaction index = No. of cycles without shortage/ Total no. of cycles = 11/12

$$SI = 0.91$$

According to the classification of satisfaction level 0.91 falls in class; this indicates a very high grade satisfaction level.

### III. SETTING UP OF HYPOTHESIS AND TESTING

Switching the operations and inventory management system takes a lot of efforts and resources. It is therefore prudent to evaluate the benefits it can bring to the overall goal- customer satisfaction.

In order to evaluate the efficiency of organizations whose operations are aided by P<sup>3R</sup> system, we designed the following statistical testing:

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

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

Level of Significance: 0.05 =  $\alpha$

The data collected on 21 real life cases of buyers based on the system as shown above is summarized as follows:

We have data for 21 buyers on the list who were switched to P<sup>3R</sup> system from their earlier P<sup>3</sup> system. The following table shows measures of satisfaction level before adopting P<sup>3R</sup> system and after adopting P<sup>3R</sup> system.

Sr. No.	Before Adoption of P <sup>3R</sup> System	After Adoption of P <sup>3R</sup> System
1	0.75	0.9
5	0.72	0.86
6	0.86	0.93
4	0.69	0.92
5	0.72	0.95
6	0.71	0.84
7	0.74	0.79
8	0.81	0.79
9	0.84	0.81
10	0.71	0.93

11	0.7	0.96
12	0.69	0.85
13	0.68	0.95
14	0.78	0.83
15	0.76	0.89
16	0.74	0.79
17	0.71	0.89
18	0.69	0.88
19	0.79	0.95
20	0.84	0.96
21	0.8	0.92

**Table 3.1: Table showing changes in SI**

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	0.75	0.9	0.15	0.0225
2	0.72	0.86	0.14	0.0196
3	0.86	0.93	0.07	0.0049
4	0.69	0.92	0.23	0.0529
5	0.72	0.95	0.23	0.0529
6	0.71	0.84	0.13	0.0169
7	0.74	0.79	0.05	0.0025
8	0.81	0.79	-0.02	0.0004
9	0.84	0.81	-0.03	0.0009
10	0.71	0.93	0.22	0.0484
11	0.7	0.96	0.26	0.0676
12	0.69	0.85	0.16	0.0256
13	0.68	0.95	0.27	0.0729
14	0.78	0.83	0.05	0.0025
15	0.76	0.89	0.13	0.0169
16	0.74	0.79	0.05	0.0025
17	0.71	0.89	0.18	0.0324
18	0.69	0.88	0.19	0.0361
19	0.79	0.95	0.16	0.0256
20	0.84	0.96	0.12	0.0144
21	0.8	0.92	0.12	0.0144

**Table 3.2: Statistical evaluation of Satisfaction Index**

$$\begin{aligned} \sum d &= 2.86 \bar{d} = 2.86/21 = 0.13619 \\ \sum d^2 &= 0.5328 \quad S^2 = 0.081542 \\ S^2 / (n-1) &= 0.081542/20 = 0.004077 \end{aligned}$$

We apply 't' test;

$$t = \frac{\bar{d}}{\left(\frac{s^2}{n-1}\right)^{1/2}}$$

t = 6.68

#### IV. DISCUSSION AND CONCLUSION

A study of 21 organizations that upgraded from P<sup>3</sup> systems of inventory management to the P<sup>3R</sup> system showed changes in customer satisfaction level operation cycles. This could be captured by changes in the Satisfaction Index. The changes in Satisfaction Index after adoption was compared with that derived from data before adoption. The data was computed to calculation of t value as per the paired t-test.

#### Conclusion:

Table value for one sided table at 20 degree of freedom at 0.05 level of significance = 1.725. Calculated value is greater than the table value and hence calculated value of 't' falls in rejection region. We therefore reject the null hypothesis and accept the alternate hypothesis H<sub>1</sub>. H<sub>1</sub>: After adoption of P<sup>3R</sup> system satisfaction level has increased.

#### V. CONCLUDING REMARKS

A well-structured statistical evaluation of the performance of 21 entities who have migrated from P<sup>3</sup> to P<sup>3R</sup> establishes that the satisfaction level of the customers have significantly increased subsequent to adoption of P<sup>3R</sup> system. This study has demonstrated the effectiveness of the P<sup>3R</sup> system, and validated its superior performance in operational and supply chain management, over the P<sup>3</sup> system. P<sup>3</sup> has already been established as having edge over conventional system such as VMI, CPFR, JIT, etc. in case of pharmaceuticals and allied products. Customer satisfaction level are directly related to customer retention. In this era of cut throat competition, P<sup>3R</sup> shall serve as a tool for sustained growth of a company.

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