A Study of Effectiveness of Behaviour Based Program in Adani Hazira Port Private Limited

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Abstract : Behavioral science is not a new topic for the industry of occupational health and safety, as its roots can be traced to 1876, wherein two different fields of science of behavioral science and industrial safety are combined to create behavior based safety program for increasing safety of the workforce, as it often happens that the worker behavior is often tied to as immediate cause in case of workplace accident or injury. In this study a review on the present behavior based safety program The objectives of the study is to investigate the effects of the fundamentals of the behavior based safety program on the Safety Acts Index, the targeted behavior. Further on, the study also aims to investigate if the process of the behavior based safety program is in control or not using the run charts from Statistical Control Techniques (SPC). It can be deduced that though the percentage on the Safety Act Index has improved, the control charts show a different picture where the entire process is out of control despite there being an improvement on the run charts, which conforms with fact that the port is still in development stage where there is room for immense development. Another problem that was commonly given in the feedback is the lack of management commitment of leadership, inability of the leadership to appreciate the hazards and over importance given to bring productivity as compared to giving equal importance on safety and production.

IndexTerms **– Behavior, safety, run charts.**

1. INTRODUCTION

Behavioral science is not a new topic for the industry of occupational health and safety, as its roots can be traced to 1876, wherein two different fields of science of behavioral science and industrial safety are combined to create behavior based safety program for increasing safety of the workforce, as it often happens that the worker behavior is often tied to as immediate cause in case of workplace accident or injury. Though there are many engineering and management practices like substitution, elimination, administrative controls, personal protective equipment, etc. which have contributed immensely to the occupational health and safety by reducing the incident rates, severity and frequency however their numbers still remain disturbing to the organization, government and customers whose immediate causes are often the worker behavior. Hence, the need for changing the behavior of the workers through behavior based safety programs.

DuPont after the implementation of Behavior Based Process have claimed that they could feel that a change in the Safe Acts Index (% Safe Acts) was a three-week predictor of an accident. This means that the observation and feedback techniques of BBS may be used to predict that safety problems may be growing in any facility and thus preventing any untoward incident.

Behaviour Based Safety (BBS), is a bottom-up approach (frontline employees), with top-down support from safety leaders and management. Behavior-based Safety process would encourage individual and group observations, positive intervention and reinforcement focused on people especially their day to day works/tasks. It also involves giving feedback in positive terms, coaching, mentoring and help setting goals which would in turn complete the loop of the ABC (Antecedent-Behavior-Consequence Model). The individuals or their workgroup must be have a proactive focus rather than a reactive one and they must be given an impetus to consider potential for accident & assess their own behaviour for any given scenario or condition.

2. METHODOLOGY DURING THE STUDY

The project work during the port happened in a very streamlined manner under the guidance of the head of department of Health, Safety, Environment and Fire Department as follows:

- The first step was a two week induction program of the major areas of the port as per the company policy.
- The next step was the project allotment where in the project of above mentioned topic (on cover) under the head of department of health, safety, environment and fire.
- Next step was the study of the behaviour based safety program that has been followed at the port in detail.
- Further on, study of the statistical process control techniques theory and the basics on application of the theory was conducted.
- The behavioural observations that are to be analysed was collected as the from the company database.
- The data was to be analysed was selected as per the guidance of my mentor at the organisation, i.e. the head of department of health, safety, environment and fire department.
- The percentage safe behaviour was calculated for the time frame selected.
- The trend of the positive observations (safe behaviours), unsafe acts and unsafe conditions (at-risk behaviours) was plot, after categorising among the major three departments of concern that are, container terminal, liquid terminal and dry cargo terminal.

- The p-chart was plot for the 3 years that are under the study for trend analysis (since when the behaviour based safety program was implemented 2015 to 2017).

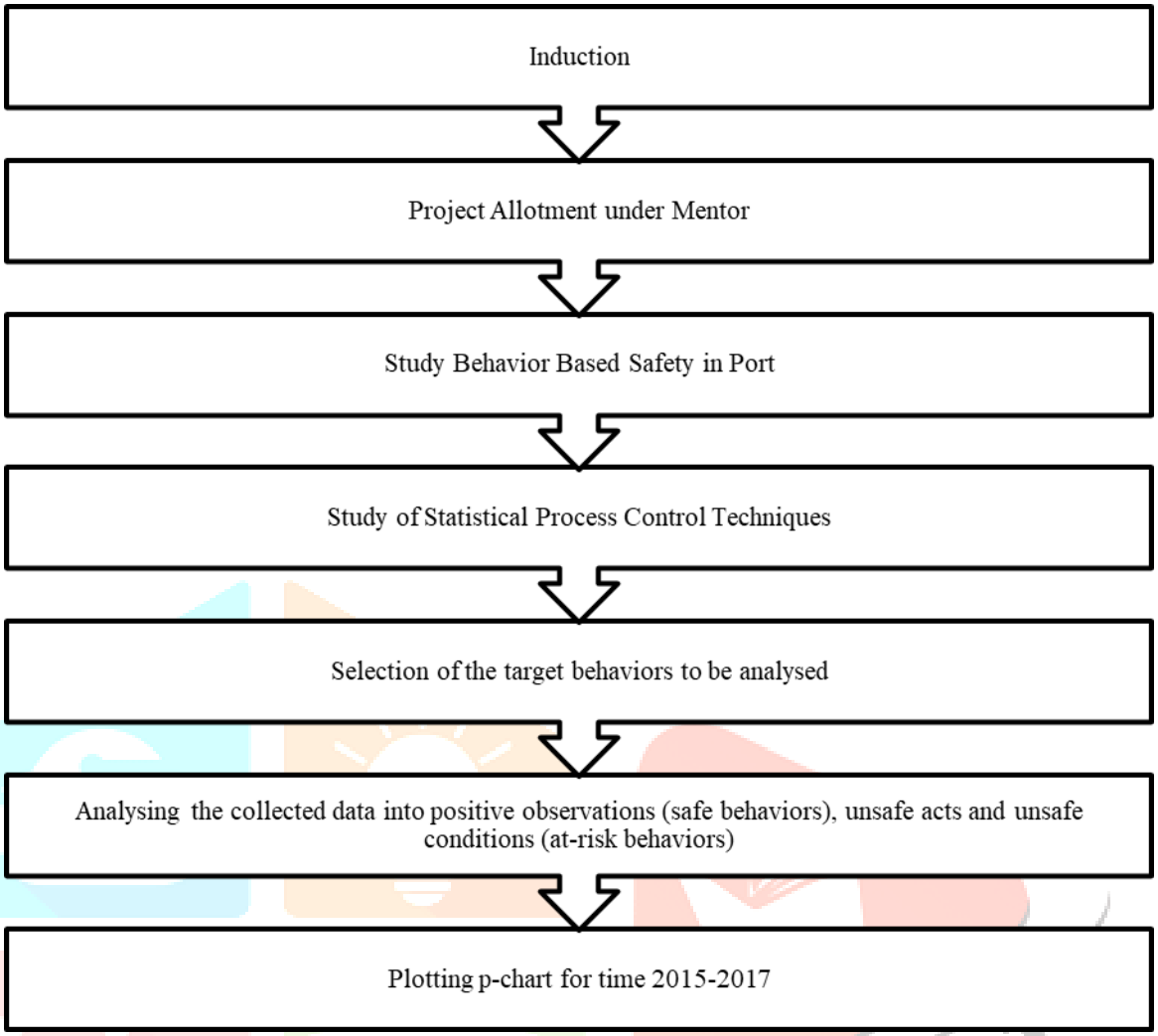

Figure 1 Flowchart of Methodology

3. BEHAVIOR BASED SAFETY PROGRAMS

Behavior-based safety programs though being common in terms of certain elements listed below, they differ in various organizations on basis of complexity and extent of application. Sulzer-Azaroff and Austin (2000) identify the following fundamental requirements:

1. Target Behaviors have to identified
2. For thorough and consistent measurement develop clear definitions in order to maintain focus and leave no room for ambiguity
3. Develop a simple yet precise method for logging behavior observations and provide proper training to the observers.
4. A suitable intervention method must be created which provides positive reinforcement and feedback about the safe work practices and target behaviors.

Critical behaviors are identified through various methods (Geller, 2001). Methods include data from the safety supervisors, managers, industry experts, injury records, near-miss reports and accidents. Identification of behavior also creates a need for making a clear & precise definition of all the identified behaviors. Thereafter, an observation checklist is generated. Then the observer would record observations as safe or unsafe using the checklist in the field. The time duration for observation should be long enough to determine the type of behavior as safe and unsafe (here, it should be noted that the employees should be aware about the Behavior Based Safety process). Using the observations we can calculate the percentage safe behavior.

Percentage of Safe Behavior = (Total Number of Safe Behaviors Observed ÷ Total Number of Behaviors Observed)

This behavior can be explained in terms of ABC Model given below:

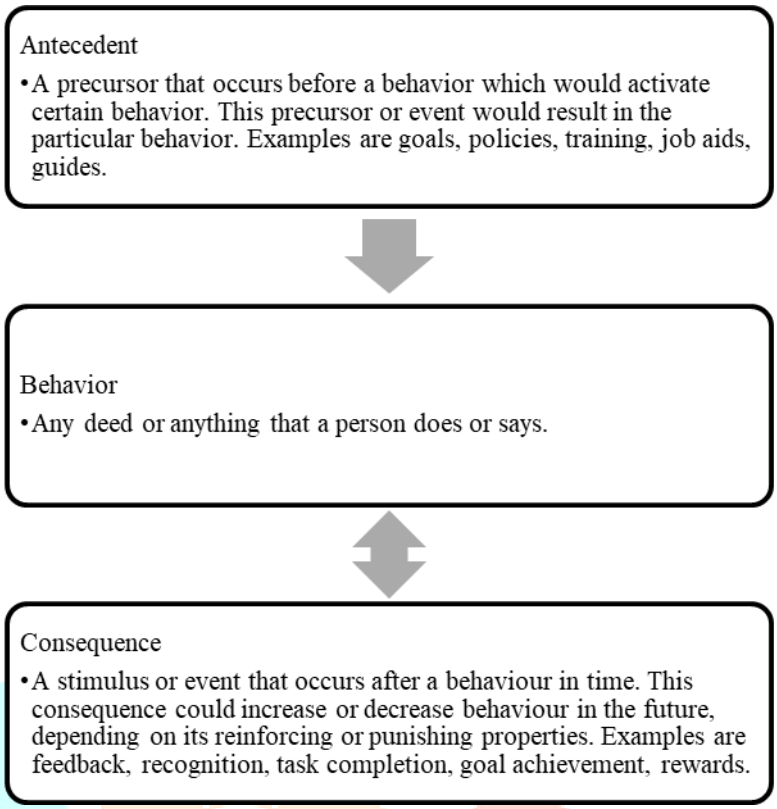

Figure 2 ABC Model

Reinforcement is that which occurs after a consequences resulting from certain behavior makes it more likely for that behavior to occur again in the future. The more the consequence is reinforcing, the more it causes for the same behavior to occur frequently. There are two types of reinforcement, namely positive and negative. Negative reinforcement means that a person behaves in certain manner to avoid bad situations. E.g. an employee wearing a safety helmet to avoid fines. Positive reinforcement means that a person is encouraged to behave in a certain manner. E.g. an employee getting a recognition from the boss, rewards, feedback, etc.

Just as the quality characteristics of a process are measured, behavior based safety can be treated as a process and its characteristics should be measured. Statistical Process Control Techniques are used to analyze any process for quality control and management which can be applied for the behavior based safety program to analyze the characteristics. Behavior observations are an example of leading safety performance indicators which helps organizations to proactively manage safety & predict any problems before an incident or injury occurs. The simplest way to represent the behavioral observations in graphical form is by using run charts (p charts, u charts, etc.). This provides information on the stability of behavior based safety process before any changes are provided. Shewhart gave the concept of Statistical Process Control techniques based on the fundamental concept of understanding changes in process through changes in variation, namely "common cause" variation and "special cause" variation. Deming (1986) has described random process variation as "common cause" variation which is caused due to causes inherent to the process. These type of variations can be predicted and are within range of certain distribution limits. Any sudden or gradual changes or "special cause" variation can be identified easily through statistical process control techniques which results due to any outside or unusual event.

4. DATA COLLECTED

The data collected here are the total observations from the month of application of behavior based safety program till January, 2018. These observations are namely classified into positive observations, unsafe conditions and unsafe acts. The percentage safe behavior is calculated using the data and represented using the graph.

The data is then used to generate p-charts for variable sample size, for which p-bar, upper control limit, lower control limit and the proportion of safe behavior among total behaviors is calculated and represented.

4.1. FORMULAS:

- Percentage of Safe Behavior = (Total Number of Safe Behaviors Observed / Total Number of Behaviors Observed)
- Total Observations = Unsafe Act + Positive Observations
- Proportion = (Positive Observations / Total Observations
- p bar = (Sum of Total Positive Observations / Sum to Total Observations)
- Control Limits are by:

$$CL_p = \bar{p} \pm 3\sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$$

Figure 3 Equation for Control Limits

Where, n = total observations
p = proportions

5. TABLES:

TABLE 5.1: MONTH-WISE OBSERVATIONS

Sr. No.	Month	Positive Observations	Unsafe Act	Unsafe Condition
1	Sep-14	0	1	0
2	Oct-14	5	144	88
3	Nov-14	11	124	138
4	Dec-14	8	59	186
5	Jan-15	15	46	124
6	Feb-15	22	53	130
7	Mar-15	29	67	115
8	Apr-15	33	57	121
9	May-15	41	75	128
10	Jun-15	37	87	135
11	Jul-15	43	81	122
12	Aug-15	35	95	137
13	Sep-15	38	106	133
14	Oct-15	47	109	129
15	Sep-15	51	103	132
16	Oct-15	55	111	123
17	Nov-15	57	117	136
18	Dec-15	41	129	137
19	Jan-16	49	116	121
20	Feb-16	57	109	124
21	Mar-16	59	107	118
22	Apr-16	45	113	131
23	May-16	61	110	121
24	Jun-16	54	116	126
25	Jul-16	62	119	119
26	Aug-16	67	115	122
27	Sep-16	55	126	138
28	Oct-16	62	119	135
29	Nov-16	66	121	127
30	Dec-16	59	126	133
31	Jan-17	69	129	135
32	Feb-17	78	117	120
33	Mar-17	72	121	128
34	Apr-17	71	126	131
35	May-17	78	122	124
36	Jun-17	74	127	133
37	Jul-17	80	122	126
38	Aug-17	83	117	122
39	Sep-17	75	125	139
40	Oct-17	79	128	142
41	Nov-17	82	131	133
42	Dec-17	85	124	138
43	Jan-18	84	116	133

TABLE 5.2: PERCENTAGE SAFE BEHAVIOUR CALCULATED

Sr. No.	Month	Positive Observations	total (ni)	% safe behavior	proportion (pi)
1	Sep-14	0	1	0	0
2	Oct-14	5	237	2.109705	0.021097
3	Nov-14	11	273	4.029304	0.040293
4	Dec-14	8	253	3.162055	0.031621
5	Jan-15	15	185	8.108108	0.081081
6	Feb-15	22	205	10.73171	0.107317
7	Mar-15	29	211	13.74408	0.137441
8	Apr-15	33	211	15.63981	0.156398
9	May-15	41	244	16.80328	0.168033
10	Jun-15	37	259	14.28571	0.142857
11	Jul-15	43	246	17.47967	0.174797
12	Aug-15	35	267	13.10861	0.131086
13	Sep-15	38	277	13.71841	0.137184
14	Oct-15	47	285	16.49123	0.164912
15	Sep-15	51	286	17.83217	0.178322
16	Oct-15	55	289	19.03114	0.190311
17	Nov-15	57	310	18.3871	0.183871
18	Dec-15	41	307	13.35505	0.13355
19	Jan-16	49	286	17.13287	0.171329
20	Feb-16	57	290	19.65517	0.196552
21	Mar-16	59	284	20.77465	0.207746
22	Apr-16	45	289	15.57093	0.155709
23	May-16	61	292	20.89041	0.208904
24	Jun-16	54	296	18.24324	0.182432
25	Jul-16	62	300	20.66667	0.206667
26	Aug-16	67	304	22.03947	0.220395
27	Sep-16	55	319	17.24138	0.172414
28	Oct-16	62	316	19.62025	0.196203
29	Nov-16	66	314	21.01911	0.210191
30	Dec-16	59	318	18.55346	0.185535
31	Jan-17	69	333	20.72072	0.207207

32	Feb-17	78	315	24.7619	0.247619
33	Mar-17	72	321	22.42991	0.224299
34	Apr-17	71	328	21.64634	0.216463
35	May-17	78	324	24.07407	0.240741
36	Jun-17	74	334	22.15569	0.221557
37	Jul-17	80	328	24.39024	0.243902
38	Aug-17	83	322	25.7764	0.257764
39	Sep-17	75	339	22.12389	0.221239
40	Oct-17	79	349	22.6361	0.226361
41	Nov-17	82	346	23.69942	0.236994
42	Dec-17	85	347	24.49568	0.244957
43	Jan-18	84	333	25.22523	0.252252

TABLE 5.3: P-CHART DATA CALCULATED

Sr. No.	Month	Proportion(p)	p-bar	Upper Control Limit	Lower Control Limit
1	Sep-14	0	0.031	0.06477	0
2	Oct-14	0.021097	0.031	0.064775	0
3	Nov-14	0.040293	0.031	0.062469	0
4	Dec-14	0.031621	0.031	0.063689	0
5	Jan-15	0.081081	0.15	0.228757	0.071243
6	Feb-15	0.107317	0.15	0.224817	0.075183
7	Mar-15	0.137441	0.15	0.223745	0.076255
8	Apr-15	0.156398	0.15	0.223745	0.076255
9	May-15	0.168033	0.15	0.218577	0.081423
10	Jun-15	0.142857	0.15	0.216562	0.083438
11	Jul-15	0.174797	0.15	0.218298	0.081702
12	Aug-15	0.131086	0.15	0.215557	0.084443
13	Sep-15	0.137184	0.15	0.214363	0.085637
14	Oct-15	0.164912	0.15	0.213453	0.086547
15	Sep-15	0.178322	0.15	0.213342	0.086658
16	Oct-15	0.190311	0.15	0.213013	0.086987
17	Nov-15	0.183871	0.15	0.210841	0.089159
18	Dec-15	0.13355	0.15	0.211137	0.088863
19	Jan-16	0.171329	0.19	0.259592	0.120408

20	Feb-16	0.196552	0.19	0.25911	0.12089
21	Mar-16	0.207746	0.19	0.259836	0.120164
22	Apr-16	0.155709	0.19	0.25923	0.12077
23	May-16	0.208904	0.19	0.258873	0.121127
24	Jun-16	0.182432	0.19	0.258406	0.121594
25	Jul-16	0.206667	0.19	0.257949	0.122051
26	Aug-16	0.220395	0.19	0.2575	0.1225
27	Sep-16	0.172414	0.19	0.255894	0.124106
28	Oct-16	0.196203	0.19	0.256206	0.123794
29	Nov-16	0.210191	0.19	0.256416	0.123584
30	Dec-16	0.185535	0.19	0.255997	0.124003
31	Jan-17	0.207207	0.232	0.301394	0.162606
32	Feb-17	0.247619	0.232	0.303349	0.160651
33	Mar-17	0.224299	0.232	0.302679	0.161321
34	Apr-17	0.216463	0.232	0.301921	0.162079
35	May-17	0.240741	0.232	0.302351	0.161649
36	Jun-17	0.221557	0.232	0.30129	0.16271
37	Jul-17	0.243902	0.232	0.301921	0.162079
38	Aug-17	0.257764	0.232	0.30257	0.16143
39	Sep-17	0.221239	0.232	0.300777	0.163223
40	Oct-17	0.226361	0.232	0.299785	0.164215
41	Nov-17	0.236994	0.232	0.300078	0.163922
42	Dec-17	0.244957	0.232	0.29998	0.16402
43	Jan-18	0.252252	0.232	0.301394	0.162606

6. DISCUSSION

The figure-4 shows that the At-risk behaviour, that is the unsafe acts and the unsafe conditions have been shown to increase rapidly as the program was implemented in year 2014 but there was dip in the same as the organization as a whole was eager to take part in reduction of at-risk behaviour and consequently the percentage safe behaviour also improved but in the year 2015 there was expansion of operations in Liquid Terminal, Container Terminal and the Dry Cargo Terminal thus the number of the at-risk behaviour also increase due to increase in the number of pool of the employees but on the other hand these values have been fairly constant as the personnel in the safety department has become more experienced and trained for reliable reporting. The number of positive observation have also increased but they have steadily increased and in very less quantity, hence the reason of the percentage safe behaviour to be very low in this case. Since the implementation of the program, people have become more observant and aware of the unsafe acts happening around them and aware about the need to report those unsafe acts and conditions. To facilitate this reporting a software named "Gensuite" has been introduced since the starting of mid of year 2015, hence the sudden increase in number of observations.

Moreover the management also provides recognition to the employees for providing observations during the monthly celebration ceremony. The p-chart is also plotted figure-5, which conforms that this Company X being a growing port, the behaviour based safety process was slightly stable during the during the first year of implementation, mainly due to expanding workforce, seasonal laborers, expansion projects' start-up, employees getting to grips with the new behaviour based safety process.

Moreover, the fig-4 also shows that the process is quiet stable, the process has shown a “special cause” variation after the in the time duration of start of the new year showing a glimpse of increase in the performance of the process which conforms the fact that at the end of every year the management reviews the entire behaviour based safety process and tries to improve the safety culture, however they have not used statistical process control. Another observation can be seen is that the organisation is focusing more on reporting of at-risk behaviours rather than focus on safe and at-risk behaviours. This misconception is still prevailing among the employees that behaviour based safety program is all about reporting the at-risk observations The fig-6 shows that the percentage safe behavior is increasing which is a positive signal of improvement of safety culture but at a snail speed'.

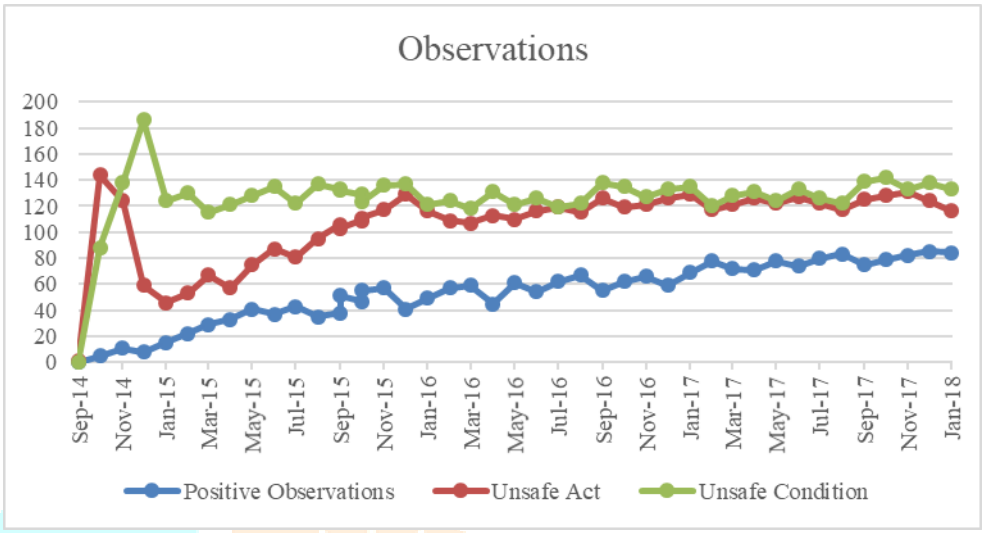

Figure - 4 Trend of the Unsafe Act & Positive Observations

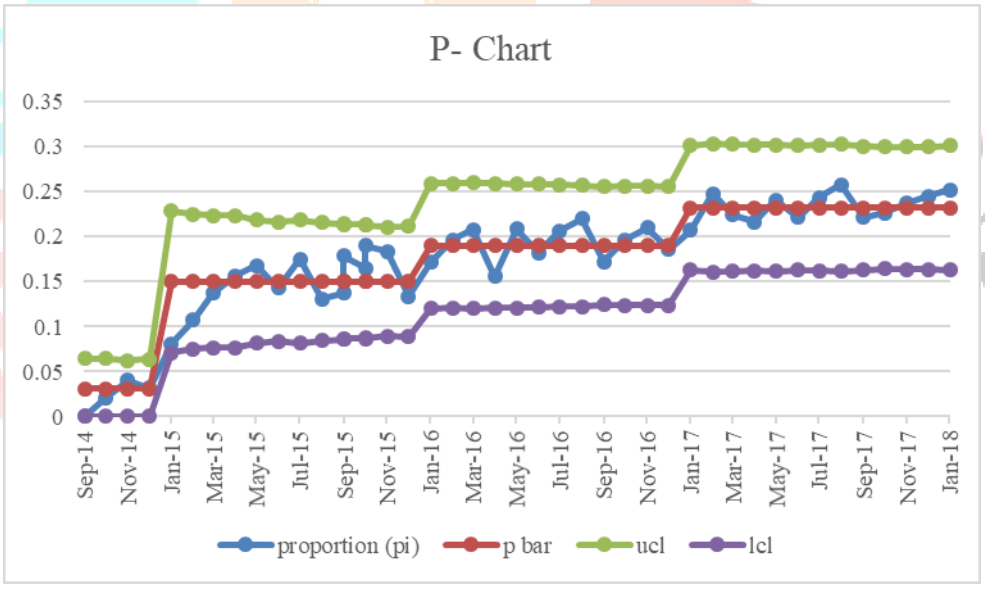

Figure – 5 P-chart of Behaviour Based Safety Program for Company X

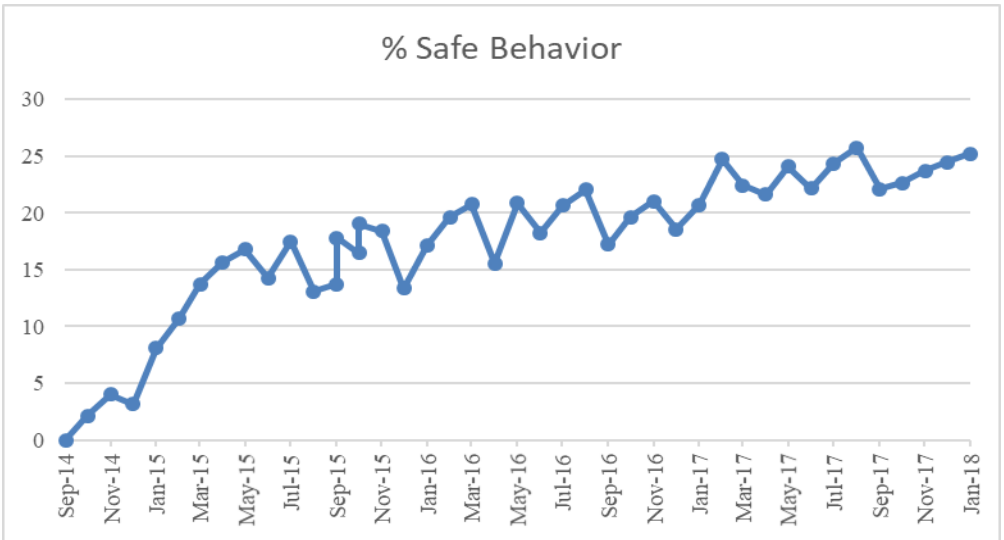

Figure – 6 Percentage of Safe behavior

7. CONCLUSION

It can be see that the behaviour based safety process for the port is a stable process but the proportion of safe behaviour is low which conforms to the fact that the organisation is growing. Also the management must re-think about the focus of the behaviour based safety program right from the top management to the employees as the perception is more to find the at-risk behaviours rather than focusing on the safe and at-risk behaviours. Moreover the p-charts depict that the process is has stabilized after the initial phase of implementation. The labourers and the employees have become more aware about the behaviour based safety program and more accepting to behaviour based safety process which is reflected in the safety percentage and increase in the positive observations. The management must deploy the method of checking the reliability of the safety supervisors or any safety department personnel and recalibrate from time to time in order to get results with accuracy as much as possible.

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