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Implementation of Accelerated Learning Program (ALP) in an Automotive Industry by Analyzing Safety Performance

A. Shameer Hussain[1], N. Pavithra[2], J. Selvan[3], A. Dennis Xavier[4]

[1 & 3]PG Student, Dep. of Applied Science & Technology, Alagappa College of Technology, Anna University, Chennai, India

[2]Project Associate, Department of Ocean Engineering, IIT, Chennai, India

[4]Industrial Engineer, SIPCOT Industrial Park, Perundurai, India

Abstract: ***This paper deals with analyzing the safety performance by virtue of a sensible approach called accelerated learning program. The implementation and analysis were carried out with basic engineering tools which highlight the loopholes associated with the safety target and invariably in the failure of achieving it. A systematic methodology depicting the bottom-up approach has been presented to an automotive Industry. The statistics about accidents have been tabulated with the help of an analysis tool. Graphical representation and trend analysis were shown to detail related aspects to fulfill the safety objectives. Finally, the management flow for the application and adaptation of ALP have been drawn which ensures the desired safety output at all levels in the work environment.***

Keywords: Analysis of Safety performance, Accelerated Training Program, Factories Act, OSHA standards, Safety 'T' Score, Incident rate, severity rate, Frequency Rate

1. Introduction

In a modern domain, propelling the workforce to work in a more safer way and supporting them the vital safety equipment is compulsory. There are many complex advancements that are exceptionally institutionalized as far as its quality and proficiency, it is conceivable to distinguish the blemishes happening in the framework that are not foreseen by the framework build. The consistency in regards to safety defects in tenets and methods give high unwavering quality in the system. Scholarly investigations give us few of the appropriate responses in regards to how to reinforce workers safety with high unwavering quality. Generally, the effect of safety authority assumes a vital part of following the security rehearses. Because of dishonorable safety or absence of security mindfulness, mischance happens in the enterprises. These mishaps prompt loss of time and cash. The cost related and time put resources into the safety framework will have its effect on the efficiency and benefit of the business. There are numerous security shapes and the most well-known strategy utilized is the customary technique for safety [1],[2]. Security specialists from different association adhering to the customary procedure keeping in mind the end goal to direct and control workforce with the objective that they exactly meet the safety benchmarks. They instructed new controls, laws and content rules for their delegates, do appraisals, survey the system, coordinate examinations of accident and wounds, and develop recommendations with a particular ultimate objective to turn away setbacks and wounds later on. For the Safety specialists, holding quick to this thought suggests changing the leadership of the worker, prodding them, and using prizes and inspirations to enable them to work securely[2]. Numerous security experts endeavor to consummate the conduct of the representatives, they utilize augmentation or impetus plans to influence them to work in a more secure way. At the point when another program is presented in an association, it should be coordinated with different elements of the framework. The wounds happening amid the occupation keep on challenging around the world. In 1998, more than 9 out of 100 authorities in the mechanical part experienced a mischief at work that required therapeutic thought (National Safety Council[NSC] 1999)[3].

Accelerated Learning Program (ALP) is a bottom-up approach where the main objective of this method is to produce safety advocates in every part of the industry. Safety advocates are produced by selecting the individuals from the bottom level of the industry, who has the enthusiasm of following safety principles by practice safety culture in the working area. The management of Godrej strongly believes that healthy environment and the good working area will promote productivity of the company[4]. According to Godrej's ALP outcome, after implementing ALP in industry, the reduction of Reportable Accidents came down to 77% & the reduction of Non-Reportable Accidents came down to 90%[4]. In an industry, without the support & help of top-level management, the safety will not prevail. The main objective of the ALP is to promote safety culture from top-level management, through which the bottom level management will follow the safety practices. The choice of directing of ALP in safety was taken to help the G&B's OHS theory as takes after: We esteem honesty, put stock in, administration, and regard for people and for nature[5]. We try to regard human life by following safety rehearses and guarantee that others to comprehend its significance. Everybody's commitment is basic components for the safety target. Safety is the lifestyle and needs to coordinate into everything that we do. Safety is about recognizable, quantifiable conduct, not observations or demeanors. Behavioral security is a result of learning and doing. Antagonistic slack results are limited when preventive conduct is empowered.

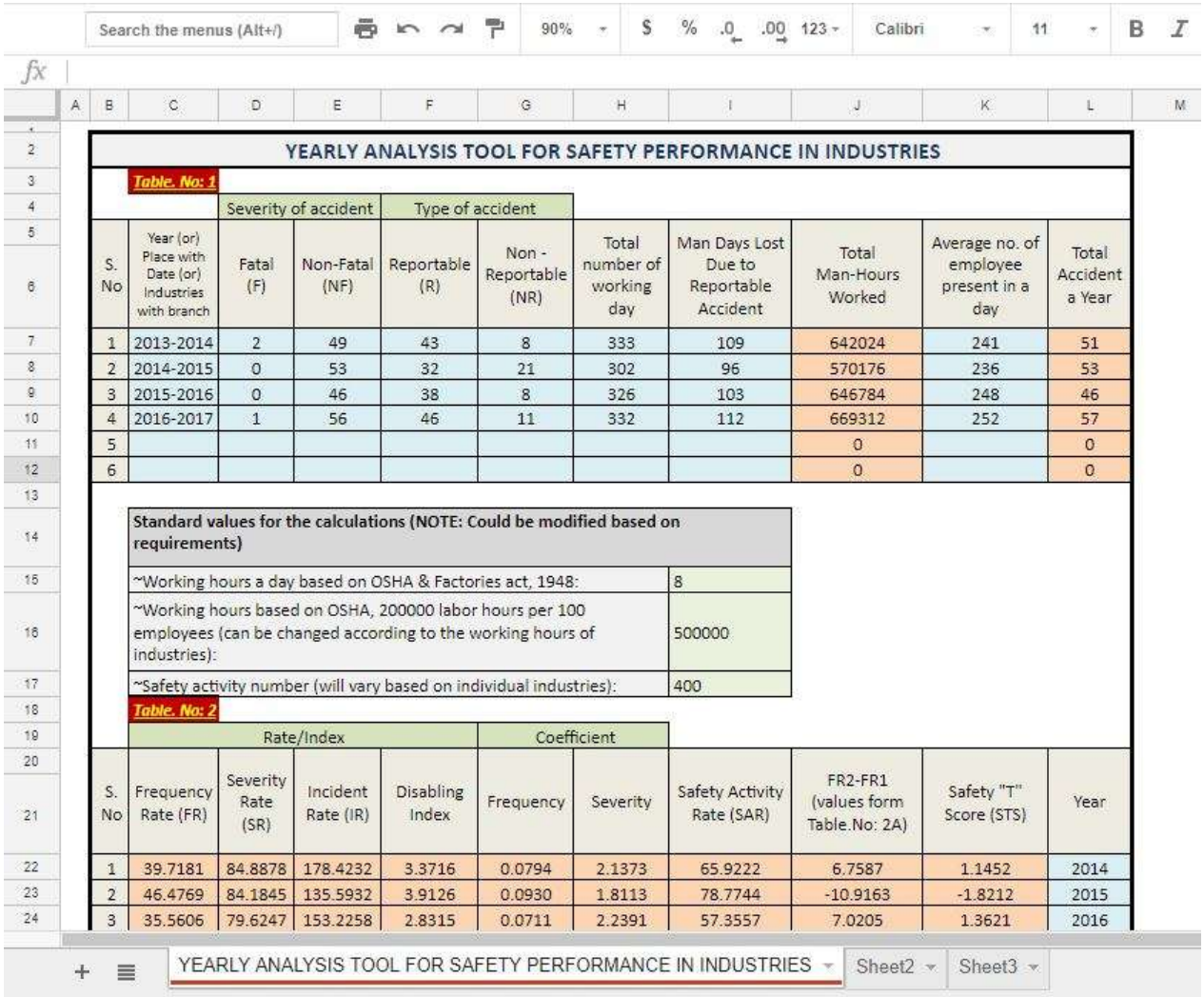
2. Hindrance to Achieve Safety Target

In an industry, the current technique for safety does not meet the security prerequisites and ensure the workforce. In this way, a step by step examine on every single procedure or operation in a specific industry must be directed. It will help in investigating and assessing the framework from the security point of view which will bring all-out safety administration logic into a setting. In this way, in light of the ALP ideas, the effective Safety 'T' Score test can be directed for an industry to diminish the mischance. And reach the safety target effectively[6].

3. Objective of the Research

a) To introduce and implement ALP concepts in the industry.
b) To produce a tool for analyzing safety performance in an industry.
c) To conduct the Safety 'T' Score for an automotive industry.
d) To interfere the outcomes of Safety 'T' Score
e) To provide a model for ALP.
f) To evaluate and analyze the system from safety aspects and provide adequate recommendations.

4. Related Work



YEARLY ANALYSIS TOOL FOR SAFETY PERFORMANCE IN INDUSTRIES

Table. No: 1

S. No	Year (or) Place with Date (or) Industries with branch	Severity of accident: Fatal (F)	Severity of accident: Non-Fatal (NF)	Type of accident: Reportable (R)	Type of accident: Non - Reportable (NR)	Total number of working day	Man Days Lost Due to Reportable Accident	Total Man-Hours Worked	Average no. of employee present in a day	Total Accident a Year
1	2013-2014	2	49	43	8	333	109	642024	241	51
2	2014-2015	0	53	32	21	302	96	570176	236	53
3	2015-2016	0	46	38	8	326	103	646784	248	46
4	2016-2017	1	56	46	11	332	112	669312	252	57
5								0		0
6								0		0

Standard values for the calculations (NOTE: Could be modified based on requirements)	
~Working hours a day based on OSHA & Factories act, 1948:	8
~Working hours based on OSHA, 200000 labor hours per 100 employees (can be changed according to the working hours of industries):	500000
~Safety activity number (will vary based on individual industries):	400

Table. No: 2

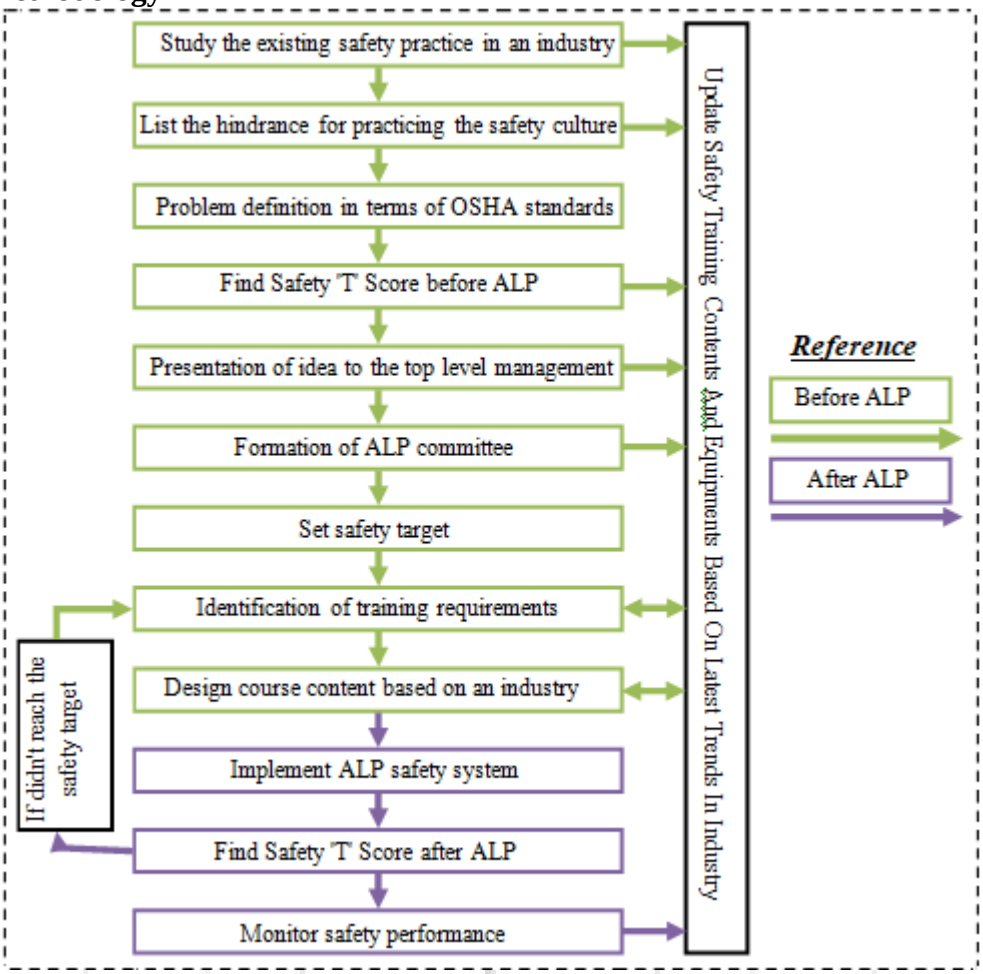
S. No	Rate/Index: Frequency Rate (FR)	Rate/Index: Severity Rate (SR)	Rate/Index: Incident Rate (IR)	Rate/Index: Disabling Index	Coefficient: Frequency	Coefficient: Severity	Safety Activity Rate (SAR)	FR2-FR1 (values form Table.No: 2A)	Safety "T" Score (STS)	Year
1	39.7181	84.8878	178.4232	3.3716	0.0794	2.1373	65.9222	6.7587	1.1452	2014
2	46.4769	84.1845	135.5932	3.9126	0.0930	1.8113	78.7744	-10.9163	-1.8212	2015
3	35.5606	79.6247	153.2258	2.8315	0.0711	2.2391	57.3557	7.0205	1.3621	2016

YEARLY ANALYSIS TOOL FOR SAFETY PERFORMANCE IN INDUSTRIES | Sheet2 | Sheet3

Figure 1: Computer-aided analysis of safety performance

The yearly analysis tool for safety performance in industries is a computer-aided tool which uses the spreadsheet as a working media(figure 1). We know that computer-aided analysis is always the best option to be considered. Because of its precision, accuracy, sensitivity & less time consumption. Through this tool, a safety engineer can easily find out the safety performance of any industry. The only aspects required are few values from the registers of the industry (which will be discussed in the future in table 1 and 2). Documentation is a foremost process to carried out day by day by safety engineers, or otherwise, the safety assessment is all about documentation of safety aspects in industry. With the help of this tool, a safety engineer can save the considerable amount of time during documentation process and can freely concentrate on more important details in industry. Using this tool is very simple, due to it uses the spreadsheet. When the input is given, all calculations are displayed instantly & the graph is materialized on the screen which is integrated with the calculated values in the spreadsheet.

5. Proposed methodology



Flow chart 1: Methodology of Accelerated Learning Program (ALP)

The methodology of Accelerated Learning Program (ALP) is performed by 12 step procedure, which is integrated with a single section of idea followed by the basis of time.

5.1 Before ALP

The first step of the model is followed by the study of existing safety practice in an industry i.e., *Study the existing safety practice in an industry.* A safety officer must study the existing safety culture in an industry, through this study one can identify and concentrate the major flaws in the existing safety culture or practice. During the process of studying the existing safety culture, one should deconstruct the operation of an industry for study. Another advantage of studying existing safety culture is, to find the feasibility of coping mechanism of newly introducing ALP model into an industry. In order to ensure that, whether the new model will prevail or not. *List the hindrance for practicing the safety culture* in an industry, is the second step of the ALP model. After the thorough study of the existing safety practices in an industry. One should list out the obstacles to an employee or for an entire industry in order to find the solution for the issues facing. Let the problem be very minor, it should be listed down, through which a safety supervisor may have the clear vision/knowledge on the issues faced by the industry to achieve the target. The listed problems should be justified in order to prove how a problem can be a problem?*(Problem definition in terms of OSHA standards)* For that one should justify the issues in terms of international standards, in that case, international standards followed by any safety committee around the globe is OSHA(Occupational Safety and Health Administration). The listed problems should be explained and justified in terms of OSHA standards. Before tend to present a new methodology to a top-level management of an industry, one should analyze the existing performance of an industry safety in a standardized way. I that way, *calculating the Safety 'T' Score before implementing ALP* is the best way to find the performance of the industry. One must *present the idea and methodology of ALP* to the top-level management of an industry. Because without the support of management of an industry the safety culture is not feasible. The safety target can only be achieved with the support of management. *Formation of ALP safety committee* is the next step of the model, it plays the vital role in the system, to prevent a system from collapsing a special committee should be formed and look over it. This ALP committee has the same responsibility and duty of standard safety committee recommended by OSHA, except it is specially designed for ALP method which will be updated to the latest trends in the technology. With the coordination of safety committee, management of the industry & low-level employee a *safety target should be fixed*. The criteria to be considered during fixing the target is,

- Practically feasible,
- It must increase the productivity of the industry,
- It should give us the expected outcome,

- The profit of the industry and the investment made for enforcing the safety should be sustained.

A target can only be achieved through proper training. An effective training can be given with the strong content. A trainer should identify the requirements in industries and the for the workers *(identification of safety training requirements)*, in ALP a safety engineer should not train their employees in traditional holistic manner. But, in specific principles, ideas, and skills. Specificity is the main advantage in ALP. ALP trainer should not train their workers with the same syllabus or course content for all workers who are performing different operations, the trainer should frame the course content *(design a course content based on an industry)* in such a way that, individual workers should experience unique training. The worker who performs CNC operations should get different safety training from the person who performs the welding operation. The training should differ workers to workers based on the operations they are performing. So, the trainer should focus on what type of operation an individual is performing and proceed to frame the content based on the individuals.

5.2 After ALP

After the ALP syllabus is framed, it should be implemented. *Implementation of ALP* is not a simple process, it should be implemented based on time and in which area of an industry it should be implemented first for trial. If trail shows us the good results, we can proceed to the major areas where the industries productions can be improved through safety training. To *monitor the safety performance* and to find how the ALP method of safety training in industry is showing impact, safety 'T' score should be done frequently (*calculating the Safety 'T' Score after implementing) ALP* based on that, the training methods and training contents should be varied accordingly. In the entire model of ALP, all steps are integrated with the syllabus update & the updated syllabus efficiency is reflected back in the safety 'T' score values. One can see how efficient the training procedures are in the values of safety 'T' score.

6. Safety performance analysis tool for industries

Table 1: Yearly Analysis Tool for Safety Performance in Industries

YEARLY ANALYSIS TOOL FOR SAFETY PERFORMANCE IN INDUSTRIES										
	Table. No: A									
		Severity of accident		Type of accident						
S. No	Year (or) Place with Date (or) Industries with branch	Fatal (F)	Non-Fatal (NF)	Reportable (R)	Non - Reportable(NR)	Total number of working day	Man Days Lost Due to Reportable Accident	Total Man-Hours Worked	Average no. of employee present in a day	Total Accident a Year
1	2013-2014	2	49	43	8	333	109	642024	241	51
2	2014-2015	0	53	32	21	302	96	570176	236	53
3	2015-2016	0	46	38	8	326	103	646784	248	46
4	2016-2017	1	56	46	11	332	112	669312	252	57
	Standard values for the calculations (NOTE: Could be modified based on requirements)									
	~Working hours a day based on OSHA & Factories act, 1948:						8			
	~Working hours based on OSHA, 200000 labor hours per 100 employees (can be changed according to the working hours of industries)[7][8]:						500000			
	~Safety activity number (will vary based on individual industries):						400			
	Table. No: B									
	Rate/Index				Coefficient					
S. No	Frequency Rate (FR)	Severity Rate (SR)	Incident Rate (IR)	Disabling Index	Frequency	Severity	Safety Activity Rate (SAR)	FR2-FR1 (values from Table. No: 2A)	Safety "T" Score (STS)	Year
1	39.7181	84.8878	178.4232	3.3716	0.0794	2.1373	65.9222	6.7587	1.1452	2014
2	46.4769	84.1845	135.5932	3.9126	0.0930	1.8113	78.7744	-10.9163	-1.8212	2015
3	35.5606	79.6247	153.2258	2.8315	0.0711	2.2391	57.3557	7.0205	1.3621	2016
4	42.5810	83.6680	182.5397	3.5627	0.0852	1.9649	67.5889	Next year inputs required		2017
~tool produced by Shameer Hussain. A										

Table 2: STS reference table

Table No C			
S. No	Reference for STS calculation	FRn	Values
1	STS1	FR1	40
		FR2	46
2	STS2	FR1	46
		FR2	36
3	STS3	FR1	36
		FR2	43
4	STS4	FR1	43
		FR2	Next year inputs required
5	STS5	FR1	
		FR2	

Safety performance analysis tool for industries spreadsheet is divided into three tables namely table A, table B & table C. Table A is mainly for giving the input values for finding the values in table B & C, formulas used for calculations and its equivalent formulas used in spreadsheets is given in Table 3. The middle portion of the table consists of values, which are taken from the OSHA standards and the factories act, 1948. Overall table, the aqua blue colored area of the spreadsheet is for entering the input values taken from the industry registers and the light orange colored area of the spreadsheet is for showing the output results of the calculated values based on our inputs. Input values to be given for calculating the values in table A is, fatal(F), non-fatal(NF), reportable(R), non-reportable(NR), total number

of working day, man-days lost due to reportable accident, average number of employees present in a day, standard working hours (based on the standards of OSHA & factories act, 1948[8]) & safety activity number (taken from the individual industry). Table C values are linked with the value of table B (i.e., calculated values) in the column FR2-FR1. Graphs 1, 2, 3 & 4 are based on the values we get from the calculations. Graphical data is based on the calculated values. As the input values in the spreadsheet changes, Output values in tables A, B & C, and graphical data changes accordingly.

Table 3: Formula used for calculation and its equivalent formulas in spreadsheet

Formulas used for calculations	*Equivalent formulas used in spreadsheet*
…. …. …. …. …. …. …. **"in a Calendar year"**	
Total man hour worked = Avg. no of employees present in one day * No. of working day in a year * 8 (Working hours basis of OSHA standard)	$=K_n*H_n*I15$
Frequency Rate = $\frac{No.of\ Accident\ X10^6}{Total\ Man\ hours\ worked}$	$=L_n*I16/J_n$
Severity Rate = $\frac{\text{Man days lost due to reportable Accident } X10^6}{\text{Total man hours worked}}$	$=I_n*I16/J_n$
Incident Rate = $\frac{No.of\ reportable\ accident\ X\ 1000}{Average\ No.of\ persons\ employed}$	$=F_n*1000/K_n$
Disabling Index = $\frac{Frequency\ rate\ X\ Severity\ rate}{1000}$	$=C_n*D_n/1000$
Frequency Coefficient = $\frac{Injuries\ X\ 1000}{Man\ hours\ worked}$	$=L_n*1000/J_n$
Severity Coefficient = $\frac{Number\ of\ man-days\ lost}{Number\ of\ Injuries}$	$=I_n/L_n$
Safety Activity Numbers = $^{\Sigma N=}N_1{}^{+}N_2{}^{+}N_3{}^{+}N_4{}^{+}$……	values from the industry register
Safety Activity Rate = $\frac{Safety\ Activity\ Number\ X\ 5\ X10^6}{Man\ hours\ worked\ X\ Avg.No.of\ Employees}$ Safety Activity Rate = $\frac{\Sigma N\ X\ 5\ X10^6}{Man\ hours\ worked\ X\ Avg.No.of\ Employees}$	$=I17*L_n*I16/(J_n*K_n)$
Safe "T" Score = $\frac{Current\ Frequency\ rate-Past\ Frequency\ rate}{\sqrt{\frac{Past\ Frequency\ Rate\ X\ 10^6}{Total\ Man\ hours\ in\ current\ year}}}$ Safe "T" score = $\frac{FR_2-FR_1}{\sqrt{\frac{FR_1\ X\ 10^6}{Total\ Man\ hours\ in\ current\ year}}}$	$=J_n/SQRT(E_n*I16/J_n)$

Note: In equivalent formulas used in the spreadsheet column, term I15, I16 and I17 are standard values referred from OSHA standards. Term L_n, J_n, F_n, K_n, C_n, D_n, I_n and E_n are used as the substitute for the term in the formulas.

7. Interpretation of Performance Analysis Tool

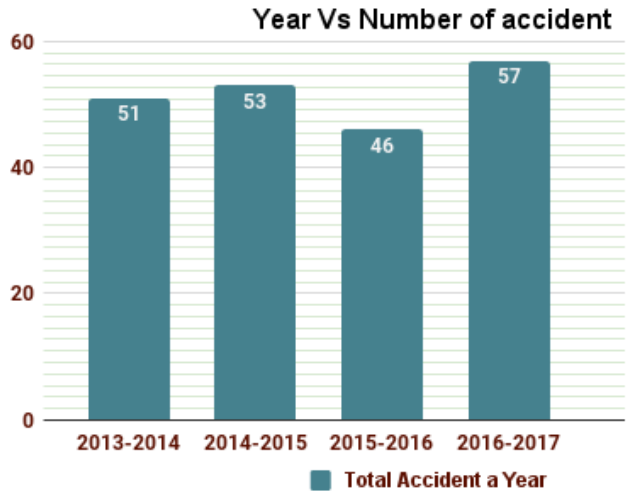


Figure 2: Year Vs Number of Accident

From the figure 2, we can see that number of accidents occurred in consecutive years. One can possibly see the fluctuations at random. Due to improper safety training, the accident rates are occurring randomly. Sometimes, it occurs less, sometimes more.

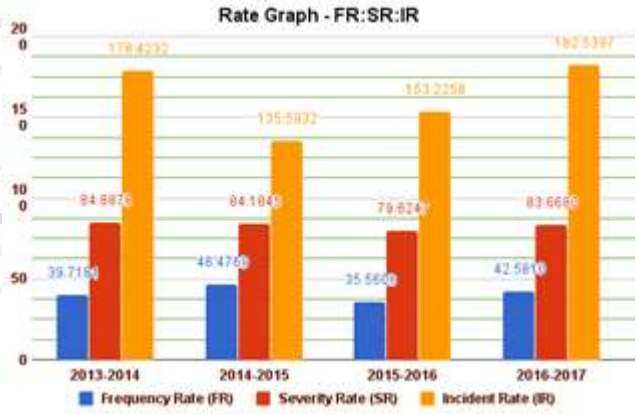


Figure 3: Rate Graph - FR:SR:IR

From the figure 3, the higher incident rate(IR) occurs in 2017, the IR is 182.5397. The higher severity rate(SR) occurs in the year 2014, the SR is 84.8878. The higher Frequency rate(FR) occurs in 2015, the FR is 46.4769. Finally, from this graph, we can conclude that number of accidents occurred in a year doesn't affect the SR, FR & IR. But, the number of man-hours lost.

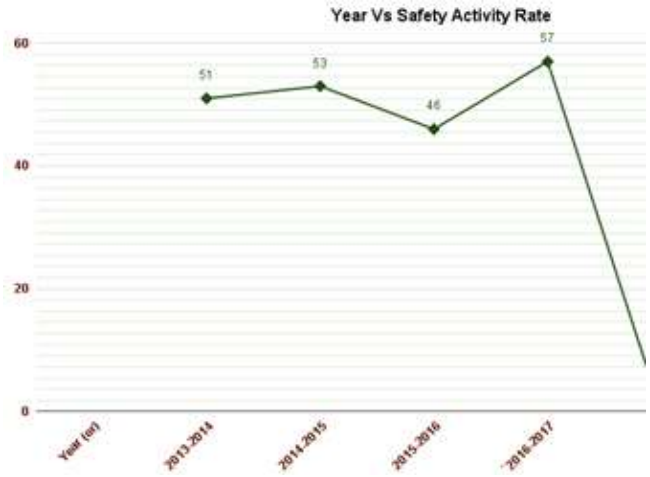


Figure 4: Year Vs Safety Activity Rate (SAR)

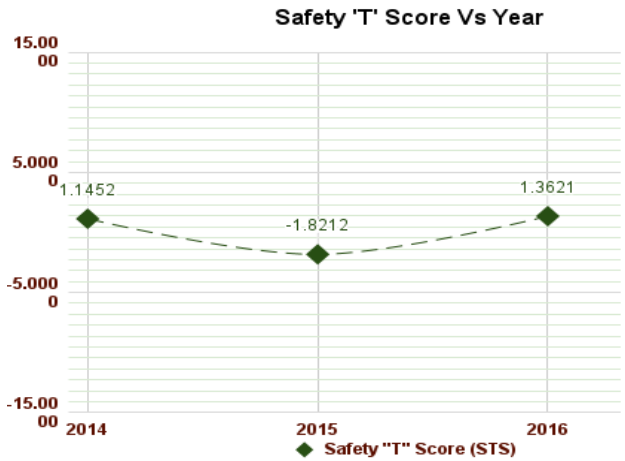
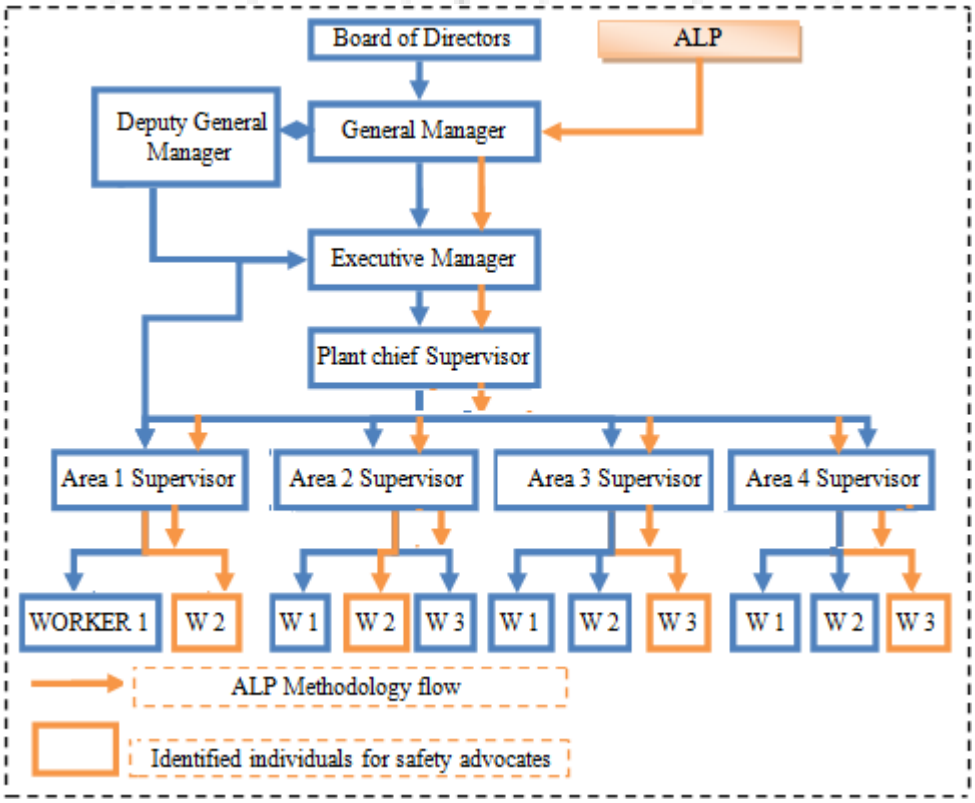


Figure 2: Safety 'T' Score Vs Year

From the figure 4, we can see that safety activity rates for consecutive years. One can see the fluctuations at random. Safety activity rate values are affected by the values of Man-hours worked, the Average number of employees present & the safety activity number.

From this above figure 5 result, we can conclude that the safety performance is decreased in 2016 compared to 2015. Positive (+) STS indicates a worsening of safety target while negative (-) STS indicates an improving safety over the past.

8. Implementation of accelerated learning program(ALP)



Flow chart 2: ALP Line Management flow

In safety sector, achieving the safety target is practically not possible without the help of management. Even though it is possible, it will be less efficient than proceeding safety with the help of management. An effective way of achieving the safety target is through the support of top-level management. In ALP model, the main objective is to implement the safety from top-level management i.e., through line management system (as shown in Flow Chart 2). The ALP implementation will be as follows:

a) Present the idea to the top level management & get approved,
b) Identify the individuals,
c) Train the individuals as a safety advocates

First the idea to be presented to the management as we discussed earlier from the Flow Chart 1. After the approval of management, the individuals should be identified. Individuals are the worker who is enthusiastic about maintaining the safe workplace, who are interested in taking extra care not only for themselves but also for their co-workers. Those individuals are interested in safety, but they lack proper training, through proper training for safety & equipment they are handling during operation the safety target can be achieved. Through these process, safety officer can create safety advocates in the workplace in every corner of the industry.

9. Conclusion

ALP training will provide the industry with sustainable environment between productivity and safety of the industry. The yearly analysis tool for safety performance in industries table that is graphically represented clearly, shows the fluctuation of accidents at random. Through the implementation of ALP in an industry, one can pinpoint the root cause of the problem & eliminate the problems one by one individually through proper training. By this method, an industry can experience the considerable amount of safety and productivity improvement, one can possibly see how ALP is reflected back in the safety output(safety 'T' score) in an industry.

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