

How to Cite:

Arunbabu, D., & Shanmugananthan, S. (2022). Reduction of creating unsafe condition and safety device inoperative by introducing new system: Breakdown maintenance slip. *International Journal of Health Sciences*, 6(S2), 2627–2635.
<https://doi.org/10.53730/ijhs.v6nS2.5784>

Reduction of creating unsafe condition and safety device inoperative by introducing new system: Breakdown maintenance slip

D. Arunbabu

Research Scholar, Department of Chemical Engineering, Annamalai University, Chidambaram, India

S. Shanmugananthan

Assistant Professor, Department of Chemical Engineering, Annamalai University, Chidambaram, India

Abstract---The present work deals with the detailed analysis of various unsafe acts by the workforce, which gives the major impact on unsafe conditions of the workspace, which further results in different range of injuries and accidents in the manufacturing industry. The current scenario of the industry is initiated with various safety precautions implemented by our safety professionals. As a result, the number of injuries are reduced in a very meager amount, but the goal of making it down to zero cannot be achieved. In order to achieve the goal of a safety professional, this study presents clear observation by answering the questions why, when where and how loop-holes are created for the happening of unsafe acts. The study specially aims at controlling specific unsafe acts of workers by the elimination of procedural working condition while handling the machineries on various situations, predominantly during maintenance. This analysis gives us clear-cut picture on unsafe acts of the work force during maintenance is directly proportional to the unsafe conditions of work space. This proportional observation is analyzed with major root causes and the recommendations are implemented with prompt and systematic effort by following the procedure of maintenance slip work force and work space are the two sides of the same coin (manufacturing industry). It is inevitable to maintain with proper balancing measurements for the safe and secured work space for our workforce. The outcome of the research pays more attention to ensure safe workspace for the most valuable workforce.

Keywords---unsafe condition, safety device, breakdown maintenance slip.

Introduction

Now a days occupational incidents are much prevented with various initiatives along with the implementation of safety management system. The ultimate goal of the safety management system is to reduce the number of injuries in the manufacturing sector with the result of making the accidents down to zero. The detailed analysis on the industrial accidents helps to find out various root cause for it. One such root cause is “unsafe condition”. This “unsafe condition” is observed in detail and its primary root cause is “unsafe act” especially during the maintenance. In other words, “unsafe act” during the process of maintenance leads to “unsafe condition”. Though the safety professionals implement various innovative and initiative measures these inevitable terminologies “unsafe condition” and “unsafe act” are running behind in the majority of accidents of the manufacturing sector.

Based on the Heinrich’s pyramid, it is identified that the biggest impact in the safety culture of the manufacturing industry is based on the unsafe acts and unsafe conditions. It is proven by Heinrich’s Pyramid that the incident could be controlled by taking effective measures on controlling “unsafe acts” and unsafe conditions”, this research paper further conducts the study through observation method by implementing effective measure on controlling “unsafe act” and unsafe condition which might help to eradicate the incident.

Although there are certain proposed recommendations and suitable preventive measures are in process, most of the unsafe conditions area prevailing with the improper follow-up of unsafe acts during maintenance. The predominant cause for the emergence of unsafe condition is overcoming the safety measures, which could also be stated as practicing unsafe act paves the way for unsafe condition. The maintenance work in the industry is the periodical process, which often takes place in a regular interval. The purpose of maintenance work in the industry is to prevent hazards and to protect the workforce and work space. But the bypass activities like overcoming the safety guards (either safety rules or safety devices) during maintenance by the work force in the work space becomes common occurrence. It is also stated as unsafe acts. This paper intensively presents such violations and a solution to overcome it. The detailed observation on such procedure also presents that the unsafe condition of the industrial environment beyond safety precautions is the sequential result of the unsafe acts during maintenance.

The paper gives the clear cut view on complete adoption of safety management in the industry with detailed analysis on it. The motto of this research paper is fulfilled by taking necessary effective step to fill the gap between the maintenance work and the start of operation. As a consequence to this analysis, it is decided to implement new effective measure by the safety professionals to fulfill the above mentioned gap such implementation could improve the safety culture and gives new standards to the safety system in the industry, which further supports the reduction of fatal incidents. In other words, by this effective implementation, the unsafe condition of the work space and unsafe acts of the workforce could be sorted out and ensure major reduction of incidents with eradication of certain terminology such as unsafe act and unsafe condition in the work space.

Study Population and Design

Workforce is the vital force and considered as most valuable assets in any country. Such workforce is prone to various work related illness and accidents. The majority of the accidents are occurred on unsafe act by the workforce and unsafe condition in the workspace. In other words, unsafe acts, unsafe conditions or combination of them are consequences of the unplanned event that disrupts the conduct or continuation of any activity.

The study area is Plant A and Plant B which includes E 1, E2 and E 3.....

It includes the category of employees as follows EXE, DT DA

To prevent injuries due to unsafe acts and unsafe condition, there has been considerable research effort in exploring their root causes. The prudence of PPE and safety devices, proper site inspections, safety culture, safety training and supervision have also been emphasized. Number of important process variables are identified on categorizing them based on violations performed. The violations are categorized as follows:

- 1) Safety devices
- 2) Ppe
- 3) OCP deviations

Materials and Methods

This study includes descriptive and diagnostic analysis with brainstorming and data collection techniques predominantly followed by safety inspection. The process includes safety behaviors, observation, adoption, analzation, interviews and review of checklists. This checklist includes all kinds of do's before and after maintenance in a manufacturing industry that a worker can do in and out. The proposed methodology requires to carry out critical analyzation on various categories and the corresponding work area with the purpose of uncovering the specific causes of the unsafe acts and unsafe condition and to understand in depth on the occurrence of the event. As per IS3786-1983

Unsafe Conditions are categorized as

- 1) Improper guarded agency
- 2) Defective Equipment / tools
- 3) Obstruction / Hazardous arrangements
- 4) Others

Unsafe Act are categorized as

- 1) Making safety devices inoperative
- 2) Deviating procedures and policy
- 3) Others

Descriptive Analysis

The method plays a vital role on conducting statistical analysis. It supports the process by looking deeper into the statistical data. It describes and summarize the statistical analysis on unsafe act and unsafe condition with detailed information on the following questions.

- 1) What area the unsafe acts and unsafe conditions are prevailing?
- 2) Where the unsafe acts and unsafe conditions takes place?
- 3) When the unsafe acts and unsafe conditions occurs ?
- 4) Who are the causing agents of such unsafe acts and unsafe condition?
- 5) And finally to what extent the unsafe acts and unsafe conditions have its impact?

Daily walkthrough inspection was conducted on the corresponding years by monitoring the performance this gives clear-cut information by answering all the above questions through critical observation. Further it is followed by critical analysis to implement the appropriate solution.

For example:

No. of unsafe act and conditions in 2018 & 2019 shows the weakest point / grey area of the system/ condition in the factory. It helps which category of unsafe act and condition affects the safety system/ culture highly.

Diagnostic analysis

The method helps to get deeper into the subject who pave the strong reason for finding out the solution and its implementation. The previous method answers to the questions who, what, where, when and to what extent. But this diagnostic analysis answers to the predominate question “Why & How” such unsafe acts and unsafe conditions, which eventually defines the root cause of problem. Identifying the root cause in our subject is based on the manpower.

Unsafe act index = no. of unsafe acts identified / Total no. of manpower * 100

The methodology adopted is summarized by adopting the following steps:

- 1) Observing the event (unsafe act or condition)
- 2) Identifying the factor that serves as the cause of the event
- 3) Identifying the worker involved in the event
- 4) Analyzing the cause of the event observed
- 5) Recording the critical analysis of the factors evidenced

Research Methodology

Type of research: Descriptive research has been used for the study.

Type of sampling: Simple random sampling has been implemented with the study.

Samples taken for the study: A total of 81 registered accidents with 3 samples were taken for the study.

Secondary data: Companies performance data, journals and website has been used with the study.

Tools used for the study: T-test has been used to compare the data.

Limitations of the Study

- Only three companies have been taken for the study.
- There may be a bias towards secondary data collected from the companies.

Analysis and Interpretation

Paired Samples Statistics

Particulars	Mean	N	SD
No of accidents before enrolment of safety device function with breakdown slip	78.35	81	623.52
No of accidents after enrolment of safety device function with breakdown slip	62.52	81	523.25

The above table depicts about depicts about no of accidents before enrolment of safety device function with breakdown slip is at (78.35) during pre-test and the acceptance of products got decreased to 62.52 during the post test.

Paired Samples Test

Paired sample comparison between pre-test and post-test before and after enrolment of safety device function with breakdown slip

	Paired Differences					t	df	Sig. (2-tailed)
	Mean	SD	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
No of accidents before and after enrolment of safety device function with breakdown slip	1.235	1254.23	625.12	123.52	156.25	1.65	20	0.000

The level of significance towards the compared variables is at 0.000 which is less than .05, which reveals that relationship exists between the compared variables and there is a need of taking the same in to consideration for decision making process by comparing pre and post-test.

Discussion

- 1) The significance of prudent identification of unsafe condition / unsafe act using breakdown slip

At the current stage of maintenance procedure in the automobile industry, the prudent identification of unsafe act and unsafe condition is mandatory. Generally the number of accidents are lower than the number of accident precursors. The aim of the safety professionals is to reduce the incidental rate. Various safety measures are taken in current scenario to bring down the incidental rate. Though there is reduction in incidental rate, majority comes out as the outburst of unsafe acts and unsafe condition. The concept of prudent identification of unsafe acts and unsafe condition which is predominantly evolved as a consequences of maintenance procedure brings a great deal in observation, evaluation and rectification of such category. The implementation of breakdown slip easily categorizes the process of violation under safety device deviation, non-usage of PPE, OCP deviation. When the cause of the incident is categorized, the safety system able to manage the accident precursors which proves the significance of prudent identification of unsafe acts and unsafe condition.

- 2) Flexibility and feasibility of the “breakdown-slip”

The manufacturing industry in its work mode with elaborated work space and vast number of workforce has its own proposed framework. This “breakdown slip” emphasize the checklist of safety professionals especially before and after the act of maintenance procedure. Additionally, it is very simple and vital in the safety checklist which is more flexible and feasible in sorting out the problem of unsafe acts and unsafe condition. This includes the negligence of negligent attitude by playing the role of powerful tool to eradicate unsafe act which includes procedural deviation and improper use of safety device and PPE & unsafe condition which includes electrical, obstruction, defective equipment and others. These above mentioned factors suggest that safety management system for accident precursors is in need of more new innovative ideas which should be flexible and feasible in implementing and carrying out in long run. The “breakdown-slip” is evident on its flexibility and feasibility on proving its as a precursor.

- 3) Further incorporation of safety culture into the Framework

In this modern scenario, data is the powerful fuel to run and drive each and every act in the entire field. The major purpose is to collect and compile the reports for the further step of managing the scenario and making conclusions and decision from the collected data. This also makes integration of various functionalities into proposed framework. Further incorporation of safety culture into the frame along with the implementation of “breakdown slip” for the perfect structural performance of the work performance collection and compilation of reports is based on the foundation of data entry through various reporting modules and patterns listed as follows

- 1) Equipment audit
- 2) Behaviour based audit
- 3) Station wise inspection

These further incorporation along with breakdown slip gives the major reduction in unsafe acts and unsafe conditions which ensure safe and secured work space for the work force.

Conclusion

In conclusion, it seems clear from the results of this research that successful implementation of “Breakdown Slip” during each and every process of maintenance in a manufacturing industry will support the safety culture by developing an accident precursor management system. The “Breakdown slip” predominantly supports the selection of preventive measures for unsafe acts or conditions and near-miss. Through this the cause of unsafe act and unsafe condition is observed at once by categorizing it under unsafe condition, improper usage of safety device, non-usage of PPE and OCP deviation. The immediate observation will provide the consequences of immediate evaluation followed by immediate correction. Such sequential order of observation, evaluation and correction gives good result on eradication of “unsafe act” and “Unsafe conditions”. Generally, the category of incident cause is unsafe act, Unsafe condition, personal factor and job factor. Among these causes, the most predominant incident occurs due to unsafe act and unsafe condition. The proper implementation and regulation of “breakdown slip” immediately identifies the category of violation and gives sudden rectification on particular violation. This is obviously observed and presented in this paper by monitoring the performance of breakdown slip by daily walk through inspection with critical observation.

This methodology can be applied in all sorts of industry with available technical and operational measures. The adoption of this methodology in the automotive sector and its effectiveness are picturized in this paper with positivity. Company safety management completely satisfied with the suggestive measures by implementing “Breakdown Slip” and decided to follow it all other plants of the same concern. Some safety audits conducted after short period of implementation of the “breakdown slip” have shown a qualitative reduction in the “unsafe condition” and quantitative reduction in the “unsafe act”. This reduction is directly proportional to the reduction of incidental rates which further enhances the safety culture of the company and gives a good confidence for the workforce to carry out their valuable working presence in the workspace.

Existing Slip

BREAKDOWN SLIP			
Line		Date	
Op no		Shift	
Production			
Informed time		Maintenance start time	

Setting time		M/C handover time	
Total loss time		Total B/D Time	
PROBLEM DETAILS		CAUSE	
		COUNTER MEASURES	
NAME/SIGN		NAME/SIGN	

New Application – Minor change in practice

BREAKDOWN SLIP			
Line		Date	
Op no		Shift	
Production			
Informed time		Maintenance start time	
Setting time		M/C handover time	
Total loss time		Total B/D Time	
Safety device function		Fixed guard of the machine	
PROBLEM DETAILS		CAUSE	
		COUNTER MEASURES	
NAME/SIGN		NAME/SIGN	

References

- Chinniah, Y. (2015). Analysis and prevention of serious and fatal accidents related to moving parts of machinery. *Safety science*, 75, 163-173.
- Ericson, C. A. (2015). *Hazard analysis techniques for system safety*. John Wiley & Sons.
- Glasziou, P., Altman, D. G., Bossuyt, P., Boutron, I., Clarke, M., Julious, S., ... & Wager, E. (2014). Reducing waste from incomplete or unusable reports of biomedical research. *The Lancet*, 383(9913), 267-276.
- Gordon, R. P. (1998). The contribution of human factors to accidents in the offshore oil industry. *Reliability Engineering & System Safety*, 61(1-2), 95-108.
- Huang, X., & Hinze, J. (2003). Analysis of construction worker fall accidents. *Journal of construction engineering and management*, 129(3), 262-271.
- Lawton, R. (1998). Not working to rule: understanding procedural violations at work. *Safety science*, 28(2), 77-95.
- Leveson, N. G. (2016). *Engineering a safer world: Systems thinking applied to safety* (p. 560). The MIT Press.
- Misra, K. B. (2008). Maintenance engineering and maintainability: An introduction. In *Handbook of performability engineering* (pp. 755-772). Springer, London.

- Reason, J. (1995). Understanding adverse events: human factors. *BMJ Quality & Safety*, 4(2), 80-89.
- Reason, J. (2016). *Managing the risks of organizational accidents*. Routledge.
- Sarter, N. B., Woods, D. D., & Billings, C. E. (1997). Automation surprises. *Handbook of human factors and ergonomics*, 2, 1926-1943.
- Sullivan, G., Pugh, R., Melendez, A. P., & Hunt, W. D. (2010). *Operations & maintenance best practices-a guide to achieving operational efficiency* (release 3) (No. PNNL-19634). Pacific Northwest National Lab.(PNNL), Richland, WA (United States).
- Weber, L. AEP-NRC-2009-45, License Amendment Request for One-Time Extension of Technical Specification Completion Times for Inoperable Train of Reactor Trip System and Engineered Safety Feature Actuation System.