

Effectiveness of Safety Management Systems in the Manufacturing Industry: A Case Study Approach

Baskaran T¹, Suresh B², Mohan S K³, Ganesh B⁴

¹Research Scholar, Department of Chemical Engineering, Annamalai University, Tamilnadu, India

²Professor, Department of Chemical Engineering, Annamalai University, Tamilnadu, India

³Professor, Department of Chemical Engineering, The Kavery Engineering College, TN, India

⁴Asst. Professor, Department of Chemical Engineering, Adhiparasakthi Engineering College, TN, India

Abstract - Manufacturing industries involve complex production processes characterized by high-risk operations, heavy machinery, and hazardous materials. These environments expose workers to significant occupational risks that may result in injuries, equipment damage, and operational disruptions. This study evaluates the effectiveness of Safety Management Systems (SMS) in manufacturing industries using statistical analysis and a case study of a medium-scale manufacturing plant. Accident data from 2017–2023 were analyzed to examine the impact of structured safety management practices. The results indicate a significant reduction in workplace incidents following SMS implementation. The study also proposes an integrated safety management framework and demonstrates 62.7% reduction in workplace incidents after SMS implementation, and improvements in safety performance indicators.

Key Words: Safety Management System, Manufacturing Safety, ISO 45001, Occupational Safety, Industrial Accidents, Risk Management

1. INTRODUCTION

Manufacturing industries represent one of the most critical sectors of economic development. However, industrial environments present numerous safety hazards including mechanical failures, electrical risks, chemical exposure, and human-machine interaction risks. Workplace accidents not only endanger employees but also lead to productivity losses, financial liabilities, and reputational damage.

Traditional safety management approaches focused primarily on reactive measures, addressing accidents only after they occurred. Modern safety practices emphasize proactive hazard identification and systematic risk control. Structured Safety Management Systems such as ISO 45001 provide systematic approach to managing occupational hazards.

Dyreborg (2024) [1] reported that companies implementing formal safety management systems experienced substantial improvements in workplace safety performance.

Joo (2023) [2] found that organizations adopting ISO-based safety systems reported improved safety awareness and reduced workplace incidents.

Yoon (2013) [3] indicates that safety management systems significantly influence accident prevention by promoting continuous monitoring and improvement of safety processes. These findings suggest that SMS implementation can be a critical factor in improving safety performance in manufacturing industries.

Chatzoglou (2022) [4] emphasized the importance of leadership commitment and worker participation in achieving effective safety management outcomes. Organizations that actively involve employees in safety activities tend to experience improved safety culture and higher incident reporting rates.

However, the effectiveness of safety management systems depends on factors such as management commitment, worker participation, safety training programs, and continuous safety monitoring.

Although previous research supports the effectiveness of safety management systems, empirical case studies evaluating their real-world impact in manufacturing environments remain limited. This study addresses this gap by analyzing accident data before and after SMS implementation.

2. METHODOLOGY

This study uses a quantitative research design combined with a case study approach to evaluate the effectiveness of safety management systems. Accident records, safety audits, training reports, incident investigation reports, and worker safety surveys were analyzed to evaluate safety performance. Key indicators included Lost Time Injury Frequency Rate (LTIFR), total incidents, and safety training participation.

2.1 Case Study: Manufacturing Facility

Pant Profile:

Industry: Automotive Component Manufacturing

Employees: 450

Production Units: Machining, Assembly, Finishing

Safety Standard: ISO 45001-based SMS

Pre-Implementation Challenges:

Prior to SMS implementation, the plant faced several issues:

- Inadequate hazard identification
- Limited safety training
- Poor incident reporting
- Lack of safety audits

SMS Implementation Strategy:

Key measures implemented included:

- Safety policy formulation
- Hazard identification and risk assessment program
- Monthly safety audits
- Worker safety training programs
- Incident reporting system
- Safety performance monitoring dashboard

Accident Trend Analysis:

Table -1: Accident Data from 2017-2023

Year	Fatal	LTI	Minor	Total
2017	2	20	45	67
2018	1	18	40	59
2019	1	16	38	55
2020	0	14	30	44
2021	0	11	26	37
2022	0	9	21	30
2023	0	7	18	25

This figure demonstrates a clear reduction in workplace accidents after the safety management system was implemented in the year 2000.

Statistical Analysis: Incident Reduction Percentage:

Incident reduction is calculated using:

$$\text{Reduction} = \frac{\text{Initial Incidents} - \text{Final Incidents}}{\text{Initial Incidents}} \times 100$$

$$\text{Reduction} = \frac{67 - 25}{67} \times 100 = 62.75\%$$

The analysis indicates that accident rates decreased by 62.7% after SMS implementation.

Lost Time Injury Frequency Rate Analysis (LTIFR):

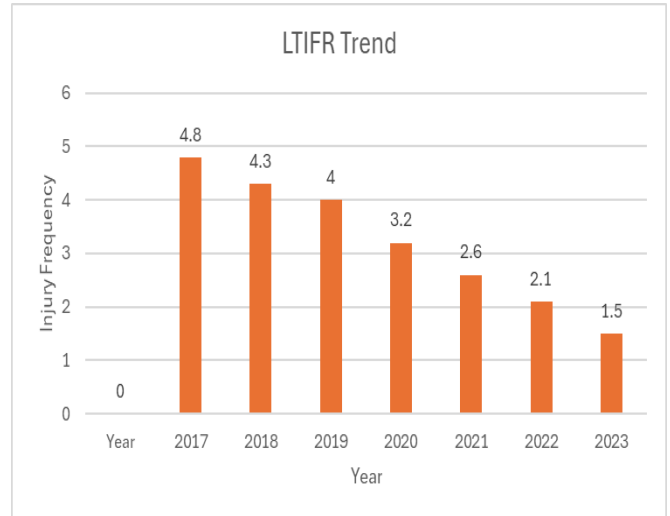


Chart -1: LTIFR Trend

This chart shows a consistent decline in accident frequency after SMS implementation.

Safety Training Participation:

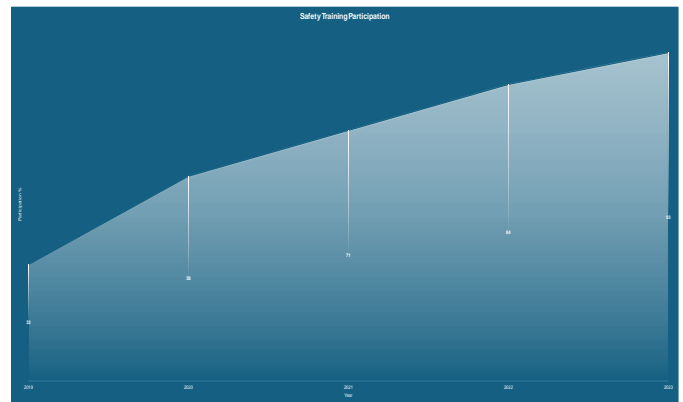


Chart -2: Worker Safety Training

The data indicates that increased safety training participation contributed to improved safety awareness and reduced accident rates.

Safety Culture Improvement:

Worker surveys revealed improvements in safety culture.

Table -2: Safety Culture

Safety Culture Survey		
Indicator	Before SMS	After SMS
Management commitment	52%	86%

Worker participation	48%	82%
Safety awareness	55%	88%

2.2 Discussion

The evaluation of safety performance indicators before and after the implementation of the Safety Management System (SMS) demonstrates substantial improvements in occupational safety outcomes within the manufacturing facility. Accident records covering the period from 2017 to 2023 reveal a clear downward trend in workplace incidents, lost time injuries, and accident frequency rates.

Prior to the implementation of the structured safety management system, the organization experienced relatively high accident frequencies due to inadequate hazard identification procedures, limited worker safety training, and reactive incident management practices. The introduction of a systematic safety framework significantly improved risk identification, safety awareness, and operational discipline.

The analysis of safety performance data reveals several important findings:

1. Workplace incidents decreased by approximately 62.7% after SMS implementation.
2. Lost Time Injury Frequency Rate decreased by nearly 68% during the study period.
3. Safety training participation increased from 33% to 93%, improving worker awareness.
4. Hazard identification procedures significantly improved workplace risk control.
5. Safety culture indicators showed strong improvement in worker engagement and management commitment.

These findings provide strong empirical evidence supporting the effectiveness of safety management systems in improving occupational safety outcomes in manufacturing environments.

The declining trend reduction in LTIFR values reinforces the conclusion that the safety interventions implemented within the organization were effective in reducing the severity of workplace injuries. In addition, safety inspections and audits conducted at regular intervals enabled the identification of unsafe conditions before accidents could occur.

Another contributing factor was the introduction of standardized work procedures and job safety analysis (JSA) for critical operations. These procedures ensured that workers were aware of potential hazards associated with their tasks and were trained to follow safe operating practices.

3. CONCLUSIONS

The study demonstrates that Safety Management Systems play a crucial role in improving occupational safety performance in manufacturing industries. The case study confirms that systematic implementation of safety policies, risk assessment procedures, employee training, and continuous monitoring can significantly reduce workplace incidents.

Key findings include:

1. SMS implementation resulted in a 62% reduction in accidents.
2. Lost time injury frequency rate decreased significantly over five years.
3. Worker participation and leadership commitment were key factors influencing safety performance.

Manufacturing industries should adopt comprehensive safety management frameworks such as ISO 45001 and Future research should focus on integrating artificial intelligence and predictive analytics into safety management systems to further enhance accident prevention strategies.

REFERENCES

- [1] Dyreborg, J. et.al., Effectiveness of OHSAS 18001 in reducing accidents at work, *Safety Science*, vol. 177, 2024,106573, <https://doi.org/10.1016/j.ssci.2024.106573>.
- [2] Ikhyun Joo, Kyungmin Baek, The consequences of ISO 45001, *Journal of Occupational Health*, vol.66, No.1,2024, <https://doi.org/10.1093/jocuh/uiad007>
- [3] Yoon, S.J., Lin, H.K., Chen, G., Yi, S., Choi, J. and Rui, Z, Effect of Occupational Health and Safety Management System on Work-Related Accident Rate. *Safety and Health at Work*, vol.4, 2013, pp. 201-209.
- [4] Prodromos D. Chatzoglou, Athanasios E. Kotzakolios, and Panagiotis K. Marhavalas, Health and Safety Management System (HSMS) and Its Impact on Employee Satisfaction and Performance- A New HSMS Model, *Safety*, vol. 11, No.2, 2025, pp.52 <https://doi.org/10.3390/safety11020052>
- [5] International Labour Organization World Day for Safety and Health at Work 2025, ISBN 9789220417706 DOI: <https://doi.org/10.54394/KNZE0733>
- [6] Bandar Saad Alshreef, The ISO 45001: A systematic review of global adoption trends, outcomes, and barriers, *International Journal of Innovative Research and Scientific Studies*, vol. 8, no.5, 2025, pp. 1127-1136

- [7] Musungwa, T., & Kowe, P, Effects of occupational health and safety management systems implementation in accident prevention, Cogent Engineering, vol.9, no.1, 2022.
<https://doi.org/10.1080/23311916.2022.2124638>
- [8] Lee J, Jung J, Yoon SJ, Byeon SH. Implementation of ISO45001, Safe Health Work., vol.11.no.4. 2020, pp. 418-424.