"Insights of Safety Risks in Non-routine Jobs and Develop a Safety Management Framework to Ensure a Sustainable Performance in Project and Shutdown Works"

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Abstract: *To meet the market demand and to sustain the competition in the global environment, automobile and auto component industries are pressurized to work continuously. Technological upgradation and maintenance are the two vital parameters for the sustenance of production. Hence it becomes hard need to take over the shutdown for repairing and replacing the equipments. Delay in which results in unplanned breakdown and degrading machine performance. Inadequate system upgrading and delay in large scale overhauling will pose a threat for long term operational continuity and uninterrupted business performance. Major correction and upgradation activities were undertaken during shutdown. Activities performed during shutdown period are referred to us as non-regular jobs or non-routine jobs. Major risk associated in these jobs are variations in the competency of manpower, quality of equipment, expertise of methods, timeline for completion, cost allotted for the project and other environmental conditions. To manage the risk in non-routine jobs, hazards need to be assessed, controlled, recorded and reviewed. An effective Safety management system will give us confidence in managing the risks. Safety management during shutdown period is a challenging project in all industries. It starts with safety training and ends up issuing and monitoring the work permits. In each stage, risk controls need to be managed efficiently. In this study, we are going to identify the significant elements in shutdown process which contribute to safety compliance. Safety survey of the people engaged in such project work has been conducted and the statistical significance has been verified using analytical tools. A structured integrated risk management system has been designed based on the analysis outcome. This will ensure sustainable performance in all non-routine jobs with zero deviations and incidents.*

Keywords: Risk management system, Maintenance, non-routine jobs, Safety compliance, Work permit system, project works

Research limitation/implications: The analysis conducted was limited to quantitative data obtained from the survey addressed to a specific group of respondents who had experienced in

supervising and handling project works. The research conducted support us to understand the significant factors that contribute to the safety performance in non-routine jobs and gave inputs for framing a structured integrated risk management system that enhances safety performance.

Introduction

Based on market demand, continuous running of production has become a part of operations in automobile industries. It is difficult to predict the market requirements and demand. Variability in the demand and fluctuating cost have become inevitable in any business. Projects need to be emphasized considering the need, investments and the returns, forecasting the upcoming scenarios. Based on customer preference, products are changed, which will influence the change in production methods. Technological adoption will improve production efficiency, reduce waste and lower energy consumption. The need for integrating digital technologies in production signifies the importance of Industry 4.0. Automobile companies started to adopt technologies in production systems enabling smart manufacturing. Integrating the technologies will make the firm more competitive in sustaining the business [2]. As we maximize our profits in the business, continuous operation will degrade the machinery, and it needs periodical maintenance. Ignoring the maintenance schedule will result in major failure of the system.

To Overcome the above scenarios, periodic maintenance programs are undertaken in all automobile industries. OEMs identifies a periodic interval for shutdowns by identifying the critical equipments in terms of risk and considering the availability and safety of the operating unit. Subsequently, auto subcomponent industries must follow the maintenance schedule as per their OEM requirements. This will improve operational efficiency in a cost-effective manner [3]. Hence focusing on driving towards the strategic goals, automobile companies and their subsidiaries undertake shutdown work to ensure more efficient operation, risk mitigation and adaptation of innovative work environment.

Risks associated with non-routine jobs

Shutdowns and project work are critical in nature. If we examine deeper, its non-routine nature makes it highly risky. Hazardous nature of work, variability in execution methods and diversity of the nature of population poses a threat to these jobs. The above elements, significantly develops potential for untoward incidents. Non routine jobs are defined as not routine works performed in an organization. These jobs are not intended to be carried out in normal conditions. Many unknown elements and unexpected circumstances need to be considered which pose a major threat during this period [4]. In majority of the organizations, these jobs are dealt by outsourcing and contracting agencies. Job requirements are not fully understood by the agencies engaged. They are unaware of the risk inherent in their jobs and it results in incidents.

Figure 1. explains the key elements which are considered as built in risk in non-routine works. Inherent risk present in non-routine jobs are as follows. (a) Ineffective in identifying and assessing the hazards, (b) Incompetent to assess the hazard and quantify the severity of the risk, (c) Approvals given without understanding and foreseeing the scenarios in the work environment, (d) Ineffective monitoring system and its controls, (e) Weak performance reviews which cannot identify, clarify and act on issues.

Figure 1. Built in risk in non routine works : Literature review & experience

All these elements result in incidents which in turn affect the morale, reputation and business performance. 1988 Piper alpha disaster resulted in 167 deaths and a financial loss of 3.4 billion dollars. Issues identified was one of the critical pumps were shut down for repair and shift crew who was incharge for that platform was not informed. Inadequate permit to work system and lockout/tagout system resulted in gaps in multiple levels of safety. Unsafe acts of the workers are another vulnerable factor which poses a major threat [5]. Different stages of escalation of unsafe acts are deviations, violations and accidents. Behavior deviations are those acts which deviate from safety rules, regulations, standards or special requirements. If deviations are not identified and corrected, it will lead to violations. Violations are those acts which are knowingly done for the ease of the process or due to negligence or overconfidence. Violations are more critical than deviations, because this will result in untoward incidents at any point of time. The above unsafe acts will affect the safety performance of the project work and cause a major loss through business interruption. Behavioural deviations are classified as Human error and violation of rules which have relationship with accidents. Reasons identified for violations are explained as it has been followed as a routine practice, there is no rule to control, no plan to improve the results or continue the activity without interruption [6].

The above said Inbuilt risks and unsafe acts cannot be averted from the non-routine jobs. But it can be managed efficiently. Activities in different stages of the shutdown works should be studied in detail. In first stage, hazards which are indigenous in nature need to be identified and effective controls need to be implemented. The next stage is the integration of these activities to effectively manage the risk in the shutdown works. This study examines the significant of risk management process in safety compliance. The research seeks to understand which are the key elements in risk management process which are significant in preventing incidents during shutdown works.

Research aims and objective

The aim of this study is to assess the relationship between Safety compliance and Risk management elements in non-routine jobs. The study has the following objectives

1) To identify the key elements of risk management processes in non-routine jobs
2) To evaluate the influence of these elements in adhering the safety compliance
3) To identify how far the model is accurate in predicting the outcome
4) Based on the results outcome, a structured approach for risk management system to be framed integrating all the risk management elements

Survey details

To achieve the above objectives, a quantitative survey was conducted across 143 work incharges who are engaged in non-routine jobs. During this survey, data collected from contract work incharges, company work incharges, safety officers and site supervisors. Survey questionnaires were carefully framed keeping the end goal in mind. Questionnaire and choices were framed based on site supervisor perspective. Their confidentiality assured aiming for the desirable outcome. The survey data collected were analyzed using statistical tool. Regression modelling was employed to identify the significance of independent variables on dependent variables. The model also explained the elements which have high significance and correlation with the safety compliance.

Significance of the Study

This research is significant for enhancing the safety performance of the shutdown jobs. By identifying the significance of the risk management elements in safety compliance, the study can frame a structured approach for the non-routine jobs which will ensure the excellence of safety performance during shutdown period.

Relationship between Safety compliance and Risk management elements in non-routine jobs

Safety has always been a threat in Non routine jobs executed in manufacturing industries. The above identified areas in Figure 1 are the important vulnerable areas which need focus and improvement. The identified built-in risk are as follows

1. Inherent risk in non-routine jobs
2. Ineffectual hazard identification
3. Inexpert assessment and permit approval
4. Poor workplace monitoring
5. Inadequate performance review
6. Impact on career and business

In major industries, operations have been equipped with additional layer of controls enabling technologies. But still accidents cannot be reduced effectively. Hence, systems need to be designed with inherently safer designs to eliminate or reduce the risks [7]. Challenges in shutdown project works are inherently complex. Demand in manpower sourcing results in delays and poor coordination. The challenges encountered affect the plant's performance and compromise safety compliance [8]. Permit to work system needs to be used for high-risk jobs and maintenance jobs. It needs to be executed by responsible individuals, plant administrators and contractors. Cases have proved that human errors and noncompliance of procedures in PTW have resulted in major disasters like Piper alpha oil and gas platform, Hickson and Welch accident in 1992 [9].

Another important risk in the above process is the engagement of different teams in executing the job. For example, Plant Engineering team will study the project requirements and come out with the budget estimation. During execution, it needs the coordination of Area authority team for workplace clearance and Plant facility team coordination for electrical supply and utility line

clearance. Finally, safety team will approve the work permit based on the compliance mentioned in work permit approval. Minor and major incidents are also very common because of the nature of their variabilities and coordinating teams.

The following risks were identified between the coordinating teams.

1. Incomplete understanding of the project work
2. Unaware of the safety requirements
3. Improper communication between the coordination teams
4. Unclear responsibilities between the teams in the project work

Ineffective controls and variations in safety compliance during non-routine jobs / project works lead to major disasters.

Because of the built in risks and poor coordination between the teams, safety compliance in project work is seen as an important criterion by any organization in manufacturing sector. Major disasters due to noncompliance will affect the organizations through

1. Operational interruption
2. Financial impact
3. Damage the reputation
4. Affects employee morale
5. Degrade the safety culture

The major risk management elements that will directly contribute to safety compliance are as follows

1. Inbuilt risk associated in each project work
2. Healthiness of the equipment's used
3. Skill level and awareness level of the people engaged
4. Overall management to monitor and review the compliance

Methodology

For ensuring the safety compliance in project works, we need to assess and manage the risk associated in each stage of the process. Integrating all the risk management stages will help us in framing a robust integrated risk management system. The above process can be demonstrated as Integrated risk management [IRM] process. This study is about the relationship between safety compliance and integrated safety management process which are non-routine in nature. **The primary objective** of this study is to evaluate the relationship between safety compliance and integrated safety management process. Comparing the effectiveness of each element and suggesting actionable insights will help us in building robust integrated safety management system. This will in turn support the automobile companies to establish and strengthen the risk management system in non-routine and project work. **To achieve these objectives** and to verify and validate the assumptions, survey has been conducted across automobile companies where project works, and non-routine jobs has become an in-built requirement to upgrade the technology for operational efficiency and to maintain the machinery in healthy running conditions without line stoppage. This quantitative survey collected data from 143 experienced people, those

who work as project incharges, contract incharges and supervisors who actively involved in non-routine jobs.

The questionnaires were framed to help us understand their experience as a part of non-routine work risk management system and its influence on safety compliance. Statistical tools like regression analysis are used to understand the significance of risk management elements in safety compliance. It also helps in understanding the correlation between the above two contents. Multiple Linear regression results enable researchers and practitioners to predict the outcomes effectively.

Hypothesis of the model was established as follows:

H0: There is no correlation/significance between safety compliance and safety management system elements

In this model, correlation and multiple linear regression is used to identify the relationship between safety compliance and integrated safety management system elements

Dependent variables (DV)

Safety compliance in non-routine jobs can be concluded from the opinion of the individuals who had experience of witnessing or being involved in accidents and incidents in their worksite. Here 60% weightage was given for the Opinion of those who experienced the accidents/ incidents and 40% weightage for those who witnessed the accidents/ incidents during their course of work.

Independent variables (IV)

Work experience (IV1), PPE adherence (IV2), Aware of the consequence of violations (IV3), impact of fatigue (IV4), Understanding of work permit requirements before starting (IV5), Participation of safety training before starting (IV6), aware of safety regulations during premeeting (IV7).

Results and discussion:

Model Fit: Regression

This Model Achieved R square 0.86 and Adjusted R square 0.85.

Table 1. Regression statistics

Regression statistics	
Multiple R	0.927
R square	0.860
Adjusted R square	0.853
Standard error	11.093
Observations	143

Multiple R values in regression statistics explains the strength of linear relationship between Safety compliance and the seven elements which are considered as Independent variables. It explains the correlation between the two variables. Multiple R value of 0.92 illustrates the strength of overall prediction accuracy. R square value explains the Proportion of total variations in dependent variable explained by the model. It has a strong explanatory power depicting 86% of the variations can be explained by the independent variables. Adjusted R square value of 0.85 which is close to R square shows that the independent variables are truly useful and improves the model accuracy. Standard error helps to determine the precision of prediction. Lower value of the standard error is better to predict the accurate outcome. **Standard error** of 11% in regression analysis indicates that the model's predictions are expected to deviate from the predicted values by an average of 11% of the time

Table 2. ANOVA

ANOVA	df	F	Significance F
Regression	7	119.012	1.46965E-54
Residual	135	-	-
Total	142	-	-

F-statistic can be understood as a set of predictor variables that are significant in explaining the variance of the dependent variable. F value is less than 0.001 which demonstrates that the overall Regression model is statistically significant, demonstrating high predictive Power.

Table 3. Regression analysis output

Regression analysis			
Integrated risk management elements	**Coefficient**	**t stat**	**p value**
Intercept	-24.422	-3.994	0.0001
IV1	-0.0272	-0.989	0.324
IV2	0.143 *	2.858	0.004
IV3	0.070	1.764	0.079
IV4	0.095*	2.686	0.008
IV5	0.263**	4.913	2.544E-06
IV6	0.191**	4.366	2.490E-05
IV7	0.479**	9.240	4.682E-16

*p < 0.01, **p < 0.001; Work experience (IV1), PPE adherence (IV2), Aware of the consequence of violations (IV3), impact of fatigue (IV4), Understanding of work permit requirements before starting (IV5), Participation of safety training before starting (IV6), aware of safety regulations during premeeting (IV7).

Let us discuss the top contributing factors in integrated risk management system which influences the safety compliances during non-routine and shutdown jobs. t Value helps to evaluate the predicators individually. Here, **t-stat** of each variable is greater than **t-critical** of 1.98, then the coefficient is considered statistically significant. Hence, we reject Null Hypothesis **(H0)** and conclude that there is significant relationship between independent variable and dependent variable. P Value helps to determine whether the coefficient is reliable and how it impacts the model. Here in our model, all our variables of P are less than 0.05. Hence the coefficient is not zero and independent variable is impacting the model. Correlation explains the strength and direction of linear relationship between the variables. There is a strong positive correlation between the safety compliance and the independent variables IV2 and IV4~IV7. The independent variable IV1 & IV3 does not significantly contribute to the intended outcome.

Statistical Interpretation of each variable

Understanding the safety regulations during Premeeting (IV7), (**β = 0.479, t = 9.24, p < .001)**

Coefficient for Understanding the safety regulations during **premeeting** (IV7) is the highest contributing factor for safety compliance. In this Case, Improvement of Score in Understanding

the Safety Regulations during premeeting by 10 points will improve the safety compliance score by 4.79 Points. This is the planning and preparation stage in the integrated manufacturing system. In shutdown projects, labours are used extensively. Shutdown activities should be planned earlier and all the relevant teams like operations, engineering, maintenance and safety team should be involved in the discussion [1]. Here the planning team & execution team should explain the jobs to be executed and their roles and responsibilities. Safety team should be an integral part of this discussion to understand the risks and deliver the appropriate safety requirements.

Understanding the **work permit requirements** before starting (IV5), **(β = 0.263, t = 4.91, p < .001)**

Work permit conditions explained and checked before the start of the work (IV5) is the second highest contributing factor. This is the execution stage where our plan and preparation were to be executed in the work area. Here verifying the permit conditions, documents and healthiness of the equipments is important. Five major weakness of the PTW were identified as inadequate training, incapable of handling PTW documents, poor coordination between takeover incharges, ineffective drive by leadership, inexpertise in auditing and techniques used. Additionally, the skill level of the people and authorization based on competence is also a significant contributing factor. Further, checking the awareness level of the workers engaged will ensure comprehensive coverage [11].

Safety training for all work incharges before the shutdown period (IV6) **(β = 0.191, t = 4.36, p < .001)**

Safety training before shutdown is yet another factor which plays a critical role in understanding and complying with the safety requirements before the shutdown activities. It was proved in many studies that there was an increase in safety compliance in shutdown period, when the safety training was specific to the major overhauls, outages, shutdowns or turnarounds (MoOSTs) [12]. Safety training session done prior to shutdown will strongly improve the desired outcome. Mandatory participation is recommended and the training contents should include previous violations, incidents, contractors' performance, hazards jobs to be executed and its safety requirements. The above contents should be presented to the people who are engaged in project work and add significant value to the results. The Overall Structured Training programme has influence on improving safety compliance.

Comfort in using **Personal protective equipments** (IV2) **(β = 0.143, t = 2.85, p < .01)**

PPE is considered as the last line of defense in safety. It plays a critical role in protecting the individuals from being harmed and if it is followed promptly, it support us in engaging manpower actively and completing the assignment. The data clearly explains that improving the comforts by 10 points will improve the safety compliance points by 1.42. From the results it was evidenced that quality and comfortability in wearing PPE significantly contributes in preventing untoward incidents during the project work.

Effect of **fatigue** in work area (IV4) **(β = 0.095, t = 2.68, p < .01)**

Fatigue is a common factor experienced by every individual in shutdown works. [10] In manufacturing industries, employees working for more hours has 88% excess risk compared to those who worked in normal hours. Fatigue has been considered as an operational risk. Fatigue risk management programmes should be implemented to measure, mitigate and manage the fatigue risks.

If it goes behind the acceptable level without monitoring and controls, it will affect the compliance of the safety requirements. Employees with less fatigue during the work will focus more on Job which improves the safety compliance.

Punishment for safety violations at work (IV3) **(β = 0.070, t = 1.76, p = 0.079)**

Disciplinary action towards safety violations and incidents remains as a moderate predictor. It will not influence the compliance significantly. This approach will bring negative impact and results in fear-based culture. This will not bring desired results for safety compliance.

Liner regression equation

SC = - 24.42 - 0.027 (IV1) + 0.143 (IV2) + 0.070 (IV3) + 0.095 (IV4) + 0.263 (IV5) + 0.191 (IV6) + 0.479 (IV7)

Inference

The study clearly demonstrates that understanding of safety regulations during premeeting and safety Training session conducted before shutdown are the strongest independent variable influencing the safety compliance. Followed by other independent variables which are reasonably influencing the safety compliance. To maximize the safety compliance in non-routine jobs, organization must focus on enforcing shutdown premeeting and safety training as mandatory requirements and build a strong basement in the early stage. Safety work permit management system, fatigue reduction methods and increasing the comfort in using PPE will further enhance the performance. Overall findings from the study support us in integrating the risk management system [IRM] in a systematic way and positively influence the safety compliance.

Integrated Risk Management process [IRM]: a structured approach

As Illustrated in Figure 2, a structured integrated risk management process is defined further to enhance the effectiveness of safety compliance in non-routine and project work.

Project safety premeeting is an important element which was identified as a most significant element during the regression analysis. It was declared as one of the powerful predictors for sa[illegible]. Three contents are very important to be discussed in this st[illegible] is [illegible] work completely. Scope, area of improvement, ma[illegible] eq[illegible]hods followed should be explained in detail by the plann[illegible] tea[illegible]ating teams and safety team. Second step is that all the r[illegible] members who are engaged in the shutdown work should be present in the meeting. Opportunity should be given for all the teams to clarify their requirements. Third step is the safety requirements and standards related to the work should be discussed and finalized. This above understanding will avoid res[illegible]untab[illegible]ntingency.

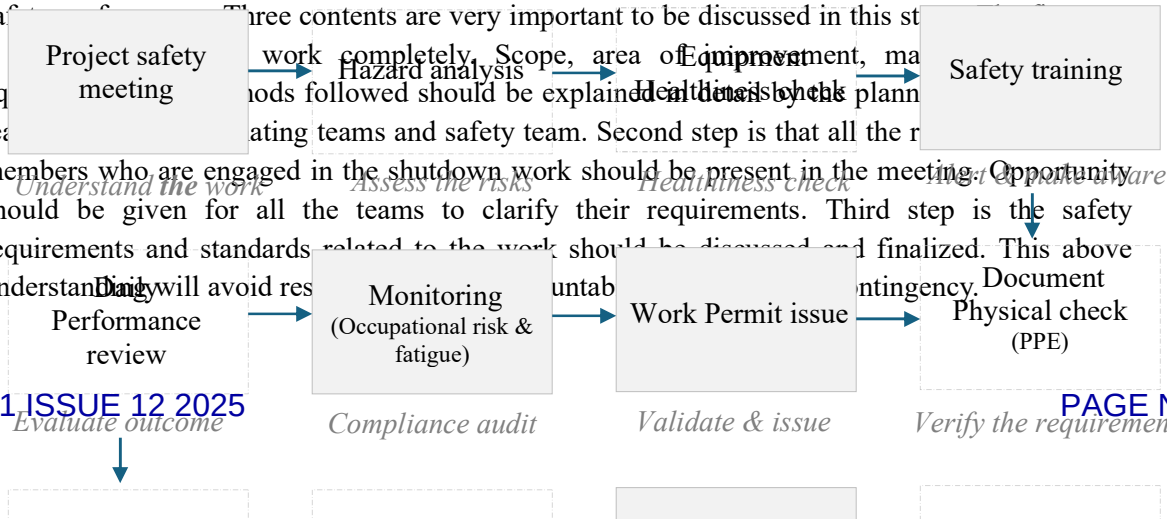

Figure 2. Integrated Risk Management system [IRM]: a structural approach

Risk assessment is the next important parameter which every organization should focus during non-routine work. Risk assessed and controls implemented with continuous monitoring will deliver effective results for routine jobs. But for non-routine jobs, it is very difficult to assess the risk foreseeing the challenges in the work and its environment. This part is quite challenging for all the incharges those who are involved in risk assessment. Important factors to be considered are the step by step split up of jobs and the risk associated in each stage. Once this is done, then identify and suggest the appropriate controls based on previous experience, standard requirements, internal requirements and some special conditions to enhance the process. Qualitative tools like HAZOP and JSA are helpful in identifying the risks. But quantitative risk assessment tools support us in identifying the risks with precision. Predictive assessment models shall be used which support safety officers to manage the high-risk jobs efficiently [13].

Material handling equipments are inevitable in any kind of project work. Major challenges in material handling equipments are the Manually moving the material, using equipment to move the materials, Working with automated material handling equipments. To overcome these challenges, healthiness of all the equipments need to be checked before the start of the project. Safety checklists need to be prepared for all the equipments in detail covering legal requirements. Contents of the checklist are to be educated to all those who are involved in the work. All equipments need to be verified for compliance with the checklist, the day before the start of project period. Identified damaged and defective equipment should be removed immediately from the sight and brought in again after correction and approval. User need to record the type of deformation and analyze it. Action can be taken considering the severity of the problem and can be kept on a noted list. Material handling equipment should be automated to improve the operational efficiency, consistency and to remove manpower labour. The automation principle of material handling mention that the operations need to be mechanized/automated wherever

feasible to improve the operational efficiency, responsiveness, consistency, predictability, and reduce operating costs, to eliminate repetitive and potentially unsafe manual labour [14].

Personal protective equipments safeguards the workers from hazards and reduces the risk of injuries during work. It restricts the exposure towards chemical hazards, physical hazards and biological hazards and protects the workers from illness and injuries. Even though we prefer Engineering controls for prevention, it is not feasible in all works. Administrative controls are preferred for Engineering controls as a next step. As a last line of defense, PPE helps in restricting the exposure to hazards. It is also included as a mandatory requirement in all acts and rules. It builds confidence among employees while working. Employees felt recognized that the management is taking care of their manpower resources. Studies reveal that the importance of PPE is understood well by all employees but there is a gap in adherence due to discomfort and inconvenience. PPE designs need to be improved based on worker's interest [15]. From the study we infer that Comfort in using the PPE has significant impact in the safety compliance. This comfort can be experienced by the employees if the management ensures the quality, standard, degree of protection and frequency of distribution. To improve the adherence, first the PPE should be selected based on hazard assessment of the process it was used. PPE with applicable standards should be recommended. It should consider the severity of the hazards and level of protection required. Employees need to be involved while selecting the PPE based on their comfort and fitness. If the above discussed points are considered during selection, it will improve the adherence and safety compliance.

Safety training is the independent variable that can significantly predict the safety performance. It should be done in two stages. In the first stage, all the members involved in the project should be called and a customized training program should be done for employees and contractors separately. Previous shutdown violations, opportunities for improvements, learnings, new standards and the risk associated with the present activities should be discussed. In the second stage, shutdown work should be started with safety peptalk on all days. This should be a mandatory forum for any kind of non-routine job. Because each day, the risk scenario changes and the workers should be educated to understand the safety requirements for the work planned on that day. Previous day violations, newly added equipments and new manpower joined need to be verified for safety compliance.

Work permit system is a mandatory legal document which needs to be followed in all non-routine jobs. From the study, we confirmed that if the workers thoroughly understood the work permit conditions and if we verify and ensure the stated requirements, we can reduce the risk associated with the non-routine jobs. For effective results, all the relevant documents related to the work permit system need to be validated by the concern user team and it should be verified and approved by safety team. Additional precautions required for the work should be intimated in the work permit document. Work permits should be approved by the authorized person designated as per the company policy. Gaps identified during work permit issue are recorded as deviations and permits will be issued after correction and proper explanation by the user team.

Onsite audit for verifying the **compliance of the work permit conditions** is one of the significant actions which ensures stability in the system. After establishing the system, **monitoring the compliance** of the requirements are important activities. Responsibility for the above lies with the key stakeholders. In the first level, it should be checked by the user incharge.

Following that it should be verified by the patrolling safety representative. Second level check should be an audit done by the safety officer who was designated for that area during shutdown period. Third level check should be an assessment by the management representative. Occupational health risks and fatigue are the important parameters to be monitored along with compliance. In our study, fatigue was identified as a significant factor for safety compliance. Ergonomics tools shall be used to identify and reduce the fatigue causing elements. However, fatigue in risky jobs poses a high risk for employees and it may lead to disasters

Daily safety performance review should be conducted by the Top management to monitor the performance of safety compliance. Work incharges, Contractor work incharges and Safety incharges should be present in the review. Safety compliance can be improved by strong leadership commitment. Leaders can enforce the rules fairly and communicate the importance of safety regulations. Strong safety leadership can persuade workers to follow safety regulations. Standard criteria for review should be derived considering the company policy, internal and legal requirements [16]. Previous day incidents, violations, deviations, near misses, non-compliances, best practices and project updates shall be a part of the agenda. Work stoppage shall be issued for critical non compliances which may lead to dangerous occurrences. Final day of the review should summarize the safety compliance status from premeeting to end of the work permit closure. Instructions shall be given regarding retraining for the group of individuals who are involved in non-compliances.

Safety training and education are used as a tool for reiterating the known requirements and educating the new requirements. But nonadherence of the existing rules and regulations needs disciplinary action. From the study we observed that the **punishment** given for violating safety rules contributes closely to significant level. It does not influence the safety performance. We also infer that; disciplinary action will not bring positive behaviour among the workers. We need to declare that it does not statistically predict the safety performance.

Still, we believe it is an important element to be considered. Government has framed acts and rules in the country to take action for the deviations, and it was included as a mandatory requirement invariably in all sectors. Stringent actions against the organization will affect their market share and business continuity. Organizations are declaring in their policies that they adhere to the local **rules and regulations** of the country. Hence, disciplinary action is considered as an inherent part of risk management system and the failure of which has huge impact in business performance.

For safety compliance, separate **disciplinary action policy** needs to be derived considering deviation, violation, incidents and noncompliance. This should be part of safety performance record for future reference. Analysis of the severity of the actions needs to be recorded. Learning should be incorporated in mandatory safety training, and it should be a part while developing new standards and internal requirements. As per procedure, policies need to be reviewed periodically for effectiveness.

Systematic management will always have a best part during the project cycle, and the best part needs to be identified and **motivated.** Based on safety performance, best team needs to be motivated in an exclusive or prime forum. Appropriate statistics in the closing report should be

used to identify the best team and individual. Best practices shall be shared with all the incharges to benchmark and follow in the future projects.

Finally, all the observations and the performance need to be **recorded** and the concern incharges need to be retrained. Continual improvement is an inherent part of safety training. Safety training materials should be updated incorporating the learnings during the project management.

Periodic maintenance and projects are undertaken in automobile industries to prevent business interruption and to introduce new models. Activities undertaken are non-routine in nature. Hence, to prevent the hazards in non-routine jobs, an integrated risk management **(IRM)** diary shall be maintained for the risk studies and standard safety protocols. This will avoid repetition of work and enhance the safety performance to the next level.

Conclusion

The results of the Multiple linear regression analysis proved that the whole model is statistically significant. The results of the study demonstrated that there is a strong relationship between safety compliance in non-routine jobs / project work and the elements of the integrated risk management process. The results of the empirical study and the results from the statistical analysis proved the strong explanatory power of the model. The study also demonstrated the strong predictors in the independent variables which shall be focused to enhance the efficiency of safety performance. Based on the results of the study, a structured approach has been framed as Integrated risk management system for ensuring 100% safety compliance. This **IRM** structured process will enhance the safety performance in non-routine / project works in automobile industries.

Besides the contribution of the above work, our study focused on the safety management of non-routine jobs in the field. Factors such as safety budget which are arising as critical parameters nowadays need to be considered. Many contracting companies can demonstrate their safety commitments by mandatory inclusion of 5 to 10% total cost of the project for safety management. Only few corporate companies have the system of communicating their safety regulation manual to the contractor company prior to submitting the quotation. Same way, in some firms, stringent safety requirements are affecting the timeline of completing the jobs as per schedule. This is resulting in Sueing penalties for the agency engaged. Further research can be explored on the above-mentioned factors and evaluate their significance to value add the structured approach in managing non-routine jobs risks more efficiently.

Declarations

All authors declare that they have no conflicts of interest.

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