

A Study of Risk and Safety Management Techniques for Aggregate Crushing Plant

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Abstract - Risks have important impact on aggregate crushing plant in terms of its primary objectives. The record of the aggregate crushing plant is not suitable in terms of managing up with risks in plant. Risk management is a process which consists of identification of risks, assessment with qualitatively and quantitatively, responses with a suitable method for handling risks, and then controls the risks by observing. This study proposes to apply the risk and safety management technique which includes well - documented procedures for the one stop solution all types of hazards most likely to occur during working crushing plant. In crushing plant many risk like as during blasting work, blasting material stocking, equipment and machinery operating and maintenance, etc. And safety hazards are inhalation of fumes smokes and dust in the quarry site cause a lot of diseases to workers, third party, people who live close to quarry sites and the immediate environment. The implication of effective risk management in quarry industry include reduction of injury and health hazards, reduction of the cost of legal claims on the company, employees will not be exposed to unnecessary dangers, will lead to more production and profitability of the plant and will also reduce environmental pollution. Many plants regularly establish a risk and safety management procedure in their projects for improving the performance, minimizing losses of accident and increases the profits with good quality. Study of this paper involves finding of 46 factors which are responsible for risk and safety in aggregate crushing plant. Findings are based on literature review, structured interview with plant experts and current scenario of crushing plant.

Keywords: -Risk Management, Safety management, Risk, Aggregate crushing plant.

INTRODUCTION

Definition of risk is a state of uncertainty where some possible outcomes have an undesired effect or significant loss. Uncertainty is meaning that the lack of certainty due to limited knowledge that it is impossible to state the outcome exactly, perhaps, more than one possible outcome happens. Risk management is the discipline of identifying, monitoring and limiting risks. In some cases, the acceptable risk may be near zero. Risks can come from accidents, natural causes and disasters as well as deliberate attacks from an adversary.

Managing risks involves identifying, assessing and prioritizing risks by monitoring, controlling, and applying managerial resources with a coordinated and economical effort so as to minimize the probability and/or impact of unfortunate events and so as to maximize the realization of project objectives (Douglas, 2009).

Management body of knowledge (Tuyszet, 2006). Effective Risk Management may lead the project manager to several benefits such as identification of favorable alternative course of action, increased confidence in achieving project objective, improved chances of success, reduced surprises, more precise estimates (through reduced uncertainty), reduced duplication of effort (through team awareness of risk control actions), etc. (Bannerman, 2008). Systemic Risk Management has an effect on the project success.

Risk exists in all the extractive activities especially in the mining and quarrying industries. In the quarrying industry, most of the activities do result to health hazards which do constitute some injuries or wounds to workers through accidents or carelessness or inadequate protection resulting from improper risk management. The inhalation of fumes smokes and dust in the quarry site cause a lot of diseases to worker, third parties and people who live close to quarry sites. Employment of people that are ill experienced and not qualified also cause a lot of damage.

OBJECTIVES OF STUDY

The primary objective of this study is to identify key risk factors that affect the aggregate crushing plant.

The secondary objectives are:

- To improve safety and health aspect at aggregate crushing plant.
- To explore possible hazards that can be occurred.
- To improve cost of the plant.
- To improve quality of aggregate.
- To reduce impact on environment.
- To exploring new techniques and machineries at the plant.

REVIEW OF LITERATURE

Hartmann et al. (1992) all Productive Maintenance and Safety Risk Management programs stress training and education as one of the primary tools used to accomplish improvements. This tool is recognized in both safety risk management and productive maintenance programs. These are dynamic systems and workers, operators and managers need to be trained how to use them.

Sheu, et al. (1994) maintenance activities are related with care a capacity's systems and machinery in working order. These activities unarguably cost companies a lot of time and money, but are a necessary business cost. In the industrial area, with maintenance costs running 15-40% of production costs, clever management has realized that maintenance, with its high cost and low efficiency, is one of the last cost saving limits.

Shakil et al. (2013) risk management ultimately minimizes the project losses & increase the likelihood that the project in completed on schedule & within the budget. Risk management is a proactive management tool used for early visibility of potential problem areas & possible mitigation measures. Risk management includes the entire project, including the design, engineering, business, contracts, finance, purchasing, estimating, & project management. Zaidi et al. (2008) says on quality and performance in roads and buildings and determines suitability of their use in Hot Mix Asphalt and Concrete Mix Design, thus addressing issues related to applicability in given situation, strength, durability and maintenance and monitoring and rehabilitation. It integrates three major facets of characterization viz. the aggregate source, the crushing plant and the basic properties obtained through physical and engineering testing. The above three facets are linked with application side where the standards come in place to define suitability of the aggregate for a given application such as concrete, asphalt etc.

Kecojevic et al. (2009) studied reports on equipment related fatal incidents and showed that underground mining equipment including continuous miners, shuttle cars, roof bolters, long wall and hoisting contributed total of 69 losses. The study revealed the major hazards resulting in fatal incidents for continuous mining equipment, shuttle cars, roof bolters and hoisting system were due to failure of target to respect equipment working area, failure of mechanical component, working under unsupported roof, failure of management to provide safe working conditions, and failure of mechanical components.

Orsulak et al. (2010) presented an application of a risk assessment approach in characterizing the risks related with safety damages in underground bituminous mines using the Mine Safety and Health Administration (MSHA) citation database. Hazard identification and risk assessment can be used to establish priorities so that the most dangerous situations are addressed first and those least likely to happen and least likely to cause major problems can be careful later. The high risk in the mine were due to the fly rock on blasting which can be reduced by the following the

steps like planning of round of shots, holes correctly drilled, direction logged, weight of explosive suitable for good fragmentation and to ensure its safe use. The problem due to the operation of large number of transport vehicles which cause lots of noise, dust and may even affect people in an accident so the roads must be properly and evenly spread for safe and comfortable movement of machines and proper traffic signals and boards should be installed over sure distance. The problem of flood can be solved by making embankments to prevent mine from flooding and if risk of happening is high then layout of seam wise working should be developed and anticipate its impact on surface features and structures and if the effect and hazards are excessive re-plan to carry them to minimum possible level. The iron ore mine is relatively safer than the aggregate mine and iron rock mine as it has various more problems like natural heating and flood which are not there in the iron rock mine but on the other hand in iron ore mine the does not take any action to overturn the dust generated after blasting and the dust is spread over large area making problems to the people living near to the mine area.

Sunday et al. (2013) says that most of the activities in the quarry industry do result to health hazards. The inhalation of fumes smokes and dust in the quarry site cause a lot of diseases to workers, third party, people who live close to quarry sites. The implication of effective risk management include reduction of injury and health hazards, reduction of the cost of legal claims on the company, employees will not be exposed to unnecessary dangers, will lead to more production and profitability of the company. Industrial sites should be located out-sketch of towns to reduce pollution; workers should be provided with safety gadgets in the quarry sites, there is need for regular environmental survey. Occupational safety is a national issue any day any time. This is in recognition of the fact that health is wealth. Good health condition is required for good production thus, effective environmental risk management in quarry industries will help reduce injures health hazard, diseases and pollution.

RISK MANAGEMENT PROCESS

Risk management process consists following step:



Figure: 1 Risk Management Process

1. RISK IDENTIFICATION

Risk management always starts with risk identification, which may be considered the most important phase of the risk management process. Its purpose is to compile a list of risks important for a particular project. To form this list, it is first necessary to research the potential sources of risk, adverse events that include risk, and the unfavorable effects of an undesirable scenario. For example, weather is a source of risk, extremely bad weather is an adverse event, and its effect is work running behind schedule due to extremely bad weather conditions. Risk identification greatly depends on the manager's experience. If his experience with particular methods and techniques of risk identification is good he will continue to use them, whereas bad experience leads to avoiding approaches prepared earlier. Figure No. 2 is various techniques for risk Identification

2. RISK ANALYSIS

Risk analysis, a component of the risk management process, deals with the causes and effects of events which cause harm. The aim behind such analysis is a precise and objective calculation of risk.



Figure: 2 Risk Identification Techniques

To the extent that this is possible, it allows the decision making process to be more certain. The essence of risk analysis is that it attempts to capture all feasible options and to analyze the various outcomes of any decision. Risk

- This is the last process of risk management and it involves the implementation of risk response to the risk
- All responses that are made to risks must be monitored and reviewed to ensure they are effective.
- Responses taken to risks should also be fully documented for future reference and project plans need to be updated accordingly. Any changes required in schedule, budget etc. due to the risk should be documented and updated in the project plans.

analysis involves assessing the identified risks. This first requires that the risks are quantified in terms of their effect on cost, time or revenue. They can be analyzed by measuring their effects on the economic parameters of the project or process. The use of risk analysis gives an insight into what happens if the project does not proceed according to plan. When active minds are applied to the best available data in a structured and systematic way, there will be a clearer vision of the risks than would have been achieved by intuition alone (Flanagan & Norman, 1993). Table 1 is various risk analysis techniques.

Table 1. Various risk analysis techniques

Risk Analysis	
Qualitative	Qualitative
• Direct judgment	• Probability analysis
• Ranking option	• Sensitivity analysis
• Comparing options	• Scenario analysis
• Descriptive analysis	• Simulation analysis

3. RISK RESPONSE PLANNING

Risk Response Planning process is the third stage in the risk management process. Action is taken to deal with the risks. Higher priority risks need more attention.

- Risk Response Planning covers both preventive actions to prevent the risk from occurring as well as a suitable response in case the risk actually occurs.
- At times, responding to a risk can give rise to a new or "secondary" risk so care should be taken when choosing a risk response.
- The five most common responses that are used to deal with risks are:
 - Risk Share
 - Risk Transfer
 - Risk Mitigation (reduction)
 - Risk Avoidance
 - Risk Acceptance

4. RISK CONTROL

- Risk Control should be an on-going process in which the impact of the risk is again evaluated and assessed.
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- Responses taken to risks should also be fully documented for future reference and project plans need to be updated accordingly. Any changes required in schedule, budget etc. due

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WORK METHODOLOGY

The work methodology included a literature search and interviews. The literature review was conducted through book, internet and journals. The data which will be collected from the questionnaires will be further analyses. As the outcome of this, 46 risk factors for aggregate crushing plant were identified. These factors were categorized in ten main groups such as: technical, logistic, management, environmental, financial, socio-political, hazards, other. Framework of the factors is given in Table 2.

The analysis solved with two types of techniques i.e. qualitative technique and quantitative technique. A qualitative analysis is risk priority matrix to be prepared for finding out the impact and probability of different types of risks on any project. This analysis will lead to the types of risks which can be a major threat to the project in terms of their objectives. With the identification of these risk types they further analyses with quantitative technique. For quantitative analysis, the identified major types of risks they can be analysed with quantitative technique. For this analysis, Monte Carlo Simulation is used for finding out the impact of risks on any project and Decision Trees can be used for finding out the probability of occurrence of the risks in any project. After the assessment of the data with both qualitative and quantitative techniques, the risk response planning is to be done for the remaining process. With the results from the assessment the risks can be avoided, transferred, reduced, shared, enhanced, exploited or accepted. The last step of the risk management process risk control is to be adopted in the monitoring process on the project after implementation of risk management.

VARIOUS TYPES OF ACTIVITIES IN AGGREGATE CRUSHING PLANT

There are many activities that take place in aggregate crushing plant like:

- Crushing of the stone
- Extraction of the stones using explosives.
- Breaking the stones with machines
- Loading the quarried material.
- Operation of the machines
- Third party coming to the premises.
- Carrying the stones/quarry to the machines
- Carrying the quarried materials.

THE DUTIES AND LIABILITIES OF THE EMPLOYER

There are three major and main duties of an employer.

- To provide proper premises, proper plant and appliances by means of which the workman's duty is to be performed.
- To maintain premises, plants and apparatus in a proper condition.
- To establish and enforce a proper way of working.

From the above major point, the employer therefore has the following liabilities.

- Premises and plants of third party
- Suitable and competent employee
- Proper system and method of working
- Selection of good plants
- Total failure to provide necessary plant
- Failure to provide sufficient plants.
- Providing defective and dangerous equipment
- Maintenance of plants - Failure to remedy known defects
- Determining of unknown defects
- Failure in carrying out repairs.

CONCLUSION

Risk management is hardly used by the members in aggregate crushing plant. The members generally use to handle the risks with a comfortable method. This technique is not employed because of less knowledge and awareness among the business trade. Hence, there is successful need to have a well-documented procedure which should be a one stop solution to all hazards that are likely to occur during production life cycle. This study was carried out particularly to identify aggregate business risk and outcome is a list of 46 number of risk and safety factors under the category of technical, logistic, financial, management, environmental, socio-political, hazards, other. Business safety is a national issue any day any time. No country takes it for granted that is why a lot of law has been enacted over the years such as, employers' liability, workmen compensation and occupational safety Acts to protect the employees and other third/parties. This is in recognition of the fact that health is wealth. Based on above factors analysis future study can be carried out to understand criticality of each factor. That kind of study will help the aggregate business to work on certain important and most critical factors so that risk can be properly managed. Good health condition is required for good production thus; effective risk and safety management in quarry industries will help reduce injures health hazard, diseases and pollution. This could better be achieved by embracing insurance because of the major role it plays in management of risk in aggregate business.

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Table: 2. RISK AND SAFTY MANAGEMENT FACTORS

A	Technical Risk
A1	Inadequate Site
A2	Incomplete Design
A3	Equipment And Tools
A4	Uncertainty of Blasting Material Availability
A5	Storage and Handling
A6	Poor Jointing Machine Parts
A7	Maintenance and Repairing
A8	New Technology
A9	Electricity Available in Crushing and Blasting Process
B	Logistic Risk
B1	Insufficiency of equipment availability
B2	Insufficiency of transportation facilities
B3	Non-availability of operators for equipment
B4	Non-availability of maintenance facility for equipment
C	Management Risk
C1	Primarily Planning
C2	Information
C3	Monitoring
C4	Co-ordination with sub –ordinates
C5	Communication
C6	Uncertain Productivity
C7	Challenging industrial Relation
D	Environmental
D1	Act of God
D2	Weather Implication
D3	Trees plantation after closed mining area
E	Financial
E1	Payment Delays

E2	Taxes Changes
E3	Royalty
E4	Plant Cost
E5	Mining Deposit Cost
F	Socio-Political Risk
F1	Licenses
F2	Govt. Policies
F3	Law
F4	Blocked Certificate
F5	Difficulties In Disposing Equipment
F6	Partnerships and Agents Issues
G	Other
G1	Change in Requirement Stock
G2	Improper Roles of Staff
G3	Insufficient Skill Staff
G4	Operator
G5	Errors
G6	Labour Disputes
G7	Over Loading Vehicles
H	Hazards
H1	Physical (Manual Handling, Height, Machinery, Injury, Electricity)
H2	Hand Tools (Noise, electrocution, Lighting)
H3	Health (Noise ,Dust ,Vibration .)
H4	Chemical (cancer, skin problems, chest problems)
H5	Biological (Tuberculosis ,Brucellastic , Hepatitis)