International Journal of Manufacturing and Material Processing
Vol. 1: Issue 2
www.journalspub.com

Risk Assessment Using WRAC Tool in a Manufacturing Industry

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Abstract

Keeping up a safe workplace is one of the imperative obligations of the management according to labour laws and to ensure the resources. The different sources of hazard in the workplace have a tendency to make harm to the workers, hardware and even the operations. Occupational Risk assessment is a process of identifying the occupational hazards that affect the workers and take steps to eliminate or control the hazards various tools are used for performing risk assessment. This paper deals with identifying the department in the industry that had accidents with consequence of higher severity and then using Workplace Risk Assessment and Control tool to identify the occupational hazards, evaluating it and suggest control measures.

Keywords: hazard, occupational risk, risk assessment, safety, WRAC

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INTRODUCTION

In the early industrial development stages the requirement of safety is of not much consideration and all the accidents were handled under common laws. The safety is workers responsibility and the management had no contribution in it. After the enactment of various acts and formation of external bodies like Occupational Safety and Health Administration (OSHA) and National Institute for Occupational Safety and Health (NIOSH) which took care of worker's safety issues, safety became a prime necessity.

The need for safety led to the development of various tools for evaluating the risks involved in the work place. The initial step in risk assessment is choosing the appropriate tool according to the requirements. A background check was done on the various tools and their usage is done for choosing the risk assessment tool.[1–20]

LITERATURE REVIEW

Wieslaw Grzybowski (2001), [21] Karkoszka and Szewieczek (2007), [6] Kania et al. (2012) [5] and Jozwik and Pietras (2013)[3] used PN-N-18002 Poland occupational safety standards for the risk assessment in the work place. Angeline Swarna and Venkatakrishnaiah (2014) [1] used FTA (Fault Tree Analysis) tool to identify the risks involved in building projects. Khaleghi et al. (2013) [19] designed an integrated tool of Fuzzy logics, ETA and LOPA for accurate analysis of the risks in a gas transport system. Ossama et al. (2013) [13] developed a combination tool of Fuzzy logic and risk matrix to overcome the disadvantages of the conventional tool. Vivek et al. (2015)[20] used Workplace Risk Assessment and Control tool for the risk assessment in cold rolling mill. Saravanakumar and Senthil Kumar [15] used HIRA technique for foundry hazard identification. Koteka and Tabas (2012) [7] developed a HAZOP tool with qualitative

risk analysis capability. Qureshi and Shakeel (2013) [9] used HAZOP to evaluate the risk management plan's effectiveness in an oil and gas sector. Mohammad fam et al. (2012) [11] proved the effectiveness of ETBA over HAZOP risk assessment tool in a chlorination unit in Tehran treatment plant. Arghami et al. (2014)[17] developed an integrated tool of HAZOP and ETBA which was used in the safety risk assessment in a gasoline refinery industry. Hwang and Jo (2013) [4] developed a modified tool by combining HAZOP and PHA for hazard identification in railway signalling. Galante et al. (2014)[2] developed an integrated tool of HAZOP, PHA and Risk matrix. Zhu et al. (2011) [22] developed a combination of Hazard theory and fuzzy logic for coal mine risk assessment. Lipol and Haq (2011) [8] made a study on the use of FMEA tool in Parker Hannifin industry. Mhetre and Dhake (2012) et al. [10] combine Ishikawa diagram and FMEA for evaluating the risk in sheet metal manufacturing company. Rakesh et al. (2013) [14] used FMEA tool in a life care product manufacturing industry for studying the subsystem breakdown. Sellappan and Palanikumar (2013) [16] modified the RPN in the FMEA tool to improve the results. Narayana *et al*. (2013) [12] used FMECA tool to identify the failure modes in the system design. Silvianita et al. [18] integrated FMEA, HAZOP, ETA and FTA to overcome the disadvantages in the various tools.

METHODOLOGY

The tool used in assessment procedure is Work place risk assessment and control (WRAC) technique. It is completely different from other risk assessment tool; it concentrates on the occupational hazards in the workplace. The WRAC tool involves inspecting the occupational hazards in the workplace, assessment of the risk and suggests safety measures to create a safe environment for the workers. Vivek et al. (2015) [20] used Workplace Risk Assessment and Control tool for the risk assessment of workplace this similar technique is used for the risk assessment. The procedure for WRAC is shown below in Figure 1. The main objective of the WRAC tools is to control or eliminate the occupational hazards.

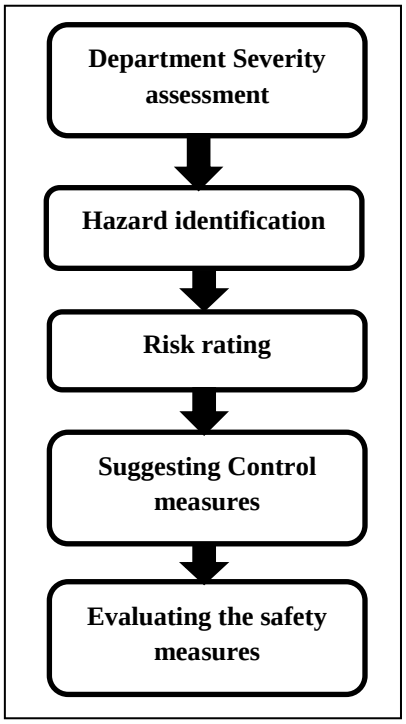

Fig. 1. *WRAC Procedure*.

Department Severity Assessment

The initial step in the risk assessment is to identify the department having the accident of the highest severity.

A survey was done on the various departments in the industry, by analysing the accident reports and interviewing the workers.

Three scales was set high, medium and low, the rating was given based on the severity (Table 1).

- High – Department having accidents with serious consequence.
- Medium – Departments having accidents of moderate level consequences.

- Low – Departments having accident of low consequence level.

Table 1. *Department Severity Assessment.*

Departments	Severity
Office	Low
Rotary switch assembly	Medium
Panel board assembly	Medium
Store	Low
Quality control	Low
Maintenance	Low
Moulding shop	Low
Crimping	Low
Tool room	Low
Power press shop	High
Despatch	Low
Canteen	Low
Security	Low
Relay assembly	Medium
Contactor assembly	Medium

Table 1 shows the assessment result. The press shop had accidents of highest severity rating mainly because of the large force involved in the blanking operation, carelessness of the workers, improper maintenance and use of PPEs.

Hazard Identification

The various hazards in the working environment were inspected. The various techniques used were manual inspection of the work place, analysing the accident report, interviewing the workers and suggestions of the department senior worker were done in order to collect information about the hazards in the shop floor.

The hazards are classified based on the situation of occurrence. Three situations were considered while machine handling, material handling and shop floor hazards.

Risk Rating

The risk rating value is calculated based on the occurrence and severity of the risks. Risk rating (RR) = occurrence (O) × severity (S). Table 2 shows the score for the likelihood and consequence based on which the rating is given.

Table 2. *Likelihood and Consequence Scores.*

Occurrence (O)	Score	Severity(S)
Rare	1	Very low
Unlikely	2	Low
Possible	3	Medium
Likely	4	High
Certain	5	Very high

Suggesting Control Measures

Safety measures are suggested to overcome the hazardous situation. The safety measures are given either to completely eliminate the hazard or control the hazards. Some safety measures like providing proper PPE, constructing barriers and maintenance.

Evaluating Safety Measures

Once the analysis process is completely finished the next step is to make sure that the safety measures are up to the level to protect the workers. The occurrence and severity scores are given after the suggestion of the safety measures and it is made sure that the risk rating value has been decreased. Regular audit is to be done to make sure the usages of the PPEs and other safety measures. Along with this, replacing the safety measures by a new one when found not to be effective (Table 3).

Table 3. *Risk Analysis.*

Machine handling hazard	O	S	R.R	Control measures	O	S	R.R
Hands accidently trapped between the die	4	5	20	Installing fixed, adjustable, self-adjustable, interlocking barrier guards	2	3	6
Improperly guarded rotating and reciprocating parts	3	4	12	Installing fixed, adjustable, self-adjustable, interlocking barrier guards	1	2	2
Scrap material splashing from the blanking process	3	2	6	Providing safety goggles	2	1	2
Improperly insulated electrical circuits	2	4	8	Proper insulation of the electrical circuit	1	3	3

Noise produced in the mechanical press	5	5	25	Providing sound proof enclosures	3	2	6
Crushing of body parts while fixing the die	4	4	16	Providing safety gloves	2	2	4
Abrasion on hands while fixing the auto feed	3	3	9	Providing safety gloves	2	1	2
Noise produced from the pneumatic unit	5	3	15	Providing ear muffs	3	2	6
Sharp edges in the machine	3	3	9	Providing insulation on sharp edges	2	1	2
Awkward postures while machining	5	3	15	Ergonomic design of the workplace	2	1	2
Static postures while machining	3	2	6	Providing properly designed chairs	2	1	2
Mal functioning of the machines	1	2	2	Proper maintenance	1	2	2
Improper position of the tools	3	3	9	Providing tool stand for the workers	1	1	1
Improper use of sharp tools	3	2	6	Providing safety gloves	1	1	1
Retrieving tools from tool box	4	2	8	Providing safety gloves	2	1	2
Improper maintenance of PPEs	3	1	3	Maintenance of the PPEs	1	1	1

Material handling hazard	**O**	**S**	**R.R**	**Control measures**	**O**	**S**	**R.R**
Manual handling of the sheet metal rolls	3	2	6	Providing trolleys	2	1	2
Repetitive work movement.	4	2	8	Proper placing of the tools within reach	1	1	1
Handling the sheet metal without using PPEs	3	3	9	Providing safety gloves	1	2	2
Chemical burns and infections	4	2	8	Chemical resistance gloves	2	1	2

Workplace hazard	**O**	**S**	**R.R**	**Control measures**	**O**	**S**	**R.R**
Poorly marked gang ways	3	4	12	Marking new gangways	1	3	3
Improperly insulated wires	2	3	6	Proper insulation of the wires	2	2	4
Uneven, slippery and damaged floors	4	3	12	Repairing the damaged floors	1	2	2
Improper shop floor layout	5	2	10	Re-planning the layout for optimised utilisation of the shop floor	2	1	2
Unwanted objects in the shop floor	3	2	6	Sorting the objects based on the requirements	1	1	1
Insufficient lightning level	2	1	2	Installing and repositioning the lamps	1	1	1
Scrap rolls on the shop floor	4	3	12	Cutting the scraps constantly	1	1	1
Dust in the shop floor	2	1	2	Surgical masks	2	1	2
Improper signs for evacuation assembly points	3	3	9	Provided proper signs for assembly points	1	1	1
Improper maintenance and cleaning of the shop floor	4	3	12	Planning regular maintenance	1	2	2
Improper bins for collecting machined metals	3	3	9	Providing bins for collection	1	2	2
Loud noise in the shop floor	5	3	15	Providing ventilation, enclosures	3	2	6
Pneumatic tubes on the floor that tends to trip the workers	4	4	16	Proper positioning of the pneumatic tubes	1	1	1

RESULT AND DISCUSSION

The risk analysis resulted in the identification of 16 machine handling hazards, 4 material handling hazards and 13 workplace hazards.

The main reasons contributing to accidents are not providing any control measure, improper selection of the PPEs, improper maintenance of the PPEs, worker's careless attitude towards the use of PPEs. Safety measures were suggested as per the requirement and the risk rating value has been brought down to a considerable level.

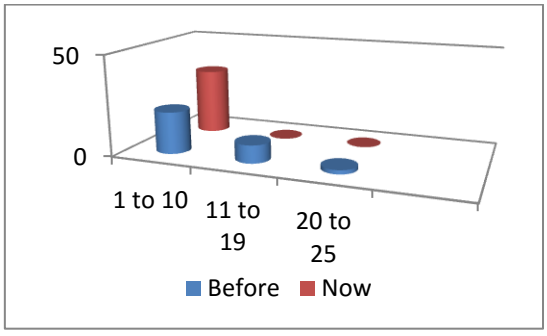

Fig. 2. *Comparison Graph.*

The risk analysis resulted in developing a safe working environment for the workers in the press shop. The Figure 2 shows the

comparison of the hazards risk ratings before and after the safety measures.

CONCLUSION

The risk analysis on the press shop disclosed many hazards that are creating an unhealthy environment for the workers. The risk rating of the hazards has been brought down by reducing the hazards likelihood level and consequence level. Further work could be done on the next department having the highest severity and reduce the risk level in the department. The WRAC tool has proven to be the most efficient tool for inspecting and accessing the hazards in work place. Regular risk assessment is supposed to be done by the management for ensuring the proper use of the safety procedures and gadgets and ensure a safe working environment.

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