Risk Assessment: A Proactive Approach to Minimizing Waste

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Introduction

Our society is currently facing various issues, including one of the worst years in terms of economy, soaring prices on natural resources, as well as concerns with regard to preservation of our environment. Due to the rising concerns on these issues, there is need for companies to modify their operations to meet these challenges or changes. Moreover, many companies are tightening their budget in order to save money, including the implementation of programs such as waste reduction, energy conservation and reduction in the use of natural resources. In other words, companies are looking for ways to cut down on expenditure. In spite of all these attempts, companies are still losing money due to incidents that lead to injuries, illnesses, death, and property damages.

In 2007, over 4 million nonfatal injuries and illnesses were recorded in United States. Furthermore, manufacturing industries had the highest incident count with 187,200 cases; the highest total recordable nonfatal occupational injury and illness incident rates; and the highest number of cases with days away from work or job transfer, including restrictions among goods producing private industry sectors. Although the total number has been declining but recent estimates place the business costs associated with occupational injuries at close to $170 billion in expenditures that come straight out of company profits. As various literatures indicate, nearly all accidents are preventable. In other words, we wasted about $170 billion dollars on accidents that could have been prevented. Utilization of risk assessment tool would not only prevent these accidents from occurring but it will also help companies to minimize waste. Occupational injuries and illnesses are not only a matter of safety and health but also matters of economics.

Lean Manufacturing and Waste Minimization

Lean concept is neither a low overhead, low cost nor fewer people. The purpose of Lean concept is to eliminate or minimize waste within an organization and to promote increase in productivity. It was originally derived from Toyota Production System. In addition, lean concept paves the way for a sustainable future of an organization. There are two fundamentals principles in a lean process. First is to identify waste and second is to eliminate the waste. Benefits from this concept are not just for the factory floor but also for various industrial sectors, even in an office environment. Today, many large corporations, as well as medium to very small companies are using or implementing Lean concept throughout their manufacturing sites.
According to Ohno, there are several forms of waste which have been identified and grouped into seven different types. These are waste due to:

1. Transportation: Waste of transportation includes any movement of material or parts which does not add value to the operation or process.
2. Inventory: Waste of inventory is when there is supply or production that is in excess of what is needed at a particular moment.
3. Motion: Waste of motion occurs when there is unnecessary movement of people or machine between manufacturing processes.
4. Waiting: Waste of waiting describes machine or operator idle time, such as waiting for a machine cycle time.
5. Overproduction: Waste of overproduction means to produce too much product, or to produce earlier than the time product is needed.
6. Over-processing: Waste of over-processing describes any process which does not add value to the product or taste of the consumer. For example, creating a process that beautifies or paints the underside of a coffee table will not add any value to the product.
7. Defects: Waste of defect refers to any process that will create scrap, rework or sorting which does not add value to the product.

Many manufacturing industries are implementing Lean manufacturing process in order to become profitable. Lean manufacturing process can be defined as a concept to achieve high-volume production using minimal inventory of raw materials. In other words, it is a process used to produce more while reducing or eliminating waste. In doing so, the management in some industries tends to ignore safety practices while putting more emphasis on lean. Moreover, they see safety procedure as a waste of production time or hindrance that needs to be eliminated. Most accidents are preventable, yet accidents are costing the United States over $160 billion dollars annually. Therefore, it would be natural to think that organizations should invest more and put additional efforts into placing strong accident prevention practices in order to reduce waste and become more profitable. That is not the case with most industries.

**Workplace Safety and Waste Reduction**

The Occupational Safety and Health Administration (OSHA) area director in Appleton, Wisconsin stated that, “Injuries such as amputation and fatalities from accidents are preventable.” One of the effective ways to prevent accident is to design out the hazards. As injury prevention is one of the vital components for survival in competitive business world, it is essential that both engineers and technologists become aware of their roles in accident prevention. There are various methods or means to protect company assets, which will lead to more production, better profit margin, accident prevention, and waste reduction. However, some manufacturing industry professionals continue to see production and safety as separate entities.

Safe environment creates opportunity for employees to come to work and go home the way they came. Although various definitions exist, safety is to minimize the risk of injury, illness, property damage and/or death from the hazards. This includes any action taken towards prevention of loss or even freedom from unacceptable risks. A component of lean manufacturing which supports health and safety is the 5s. It is a widely used process for workplace organization which helps to protect the health and safety of employees and their environment. 5s consists of Sort, Sweep, Straighten, Standardize, and Sustain.
We will need to analyze the effects of lean and safety in a workplace. This will help to promote the integration of lean with occupational safety in order to achieve acceptable risk as we minimize waste. Employee injuries or death is not only pain and suffering of an individual but also waste in the system. Each incident not only creates waste to the company in the form of tangible costs such as medical bills or workers’ compensation cost but also there are other hidden or indirect costs. Those hidden costs include lost time due to an investigation, lost production due to an accident, clerical time to arrange investigation, and the list goes on. As indicated earlier in the definition of lean process, there are two questions that must be asked in order to start a lean process. The first question is; where are we wasting the most resources like time, people and materials? Next question is; how can we minimize the waste? The answers to these questions will help to understand the relationships between Lean and Safety in a workplace.

**Risk Assessment and its Role in Waste Minimization**

One of the concepts known to safety professionals and used to control incident is the 3Es of safety: Engineering, Education and Enforcement. With 3Es concept, the first step to controlling hazards is by implementing engineering control. Education comes second where organizations will need to educate their employees with regard to hazards they are exposed to and risk they are facing. The third is to enforce the safety rules or policy and the end results of the concept will lead to waste reduction in a system.

In essence, designing out hazards are the best method to control accidents. Using the risk assessment technique, one could design out those hazards that could potentially harm both employees and the company. Injury, illness or even death is not only suffering and pain to an individual but also a waste in the system. Moreover, organizations wishing to implement the lean concept will need to incorporate safety into their system. Therefore, safety during the designing stage should be emphasized in planning engineering and technology programs.

Hazards can be designed out by utilizing risk assessment process. Although variation exists, Risk Assessment Process should include the following:

1. **Hazard identification**: Includes all the processes used to gather information in order to determine the possible risk potentials that will cause employee adverse health conditions.
2. **Assessment of hazards**: This could be any procedure to verify the presence of hazards such as physical, chemical or gaseous hazards to which employees may be exposed to.
3. **Determination of control techniques or risk reduction**: Risk reduction includes all steps or techniques which are used to minimize the severity of identified and assessed hazards.
4. **Selecting techniques for implementation**: This is the process of selecting the appropriate technique from (3) above, which will be used to measure each identified risk.
5. **When to reach acceptable risk**: The idea that everything has its limit should also apply to risk assessment. Management must avoid spending too much time and resources in risk assessment that will never occur. In other words, performing very costly and irrelevant risk assessment is not needed and will constitute waste by lean standard definition.
6. **Evaluation and documentation**: In most cases, written document such as risk assessment procedure turns out to be a policy which will need documentation and periodic evaluation. Evaluation is important to make sure that selected techniques are still
applicable and effective and also to ascertain that the risk level in the environment has not changed.

Mike Douglas, an engineer with General Motors developed a two-stage approach used in Risk Assessment. It is known as the 2 keg-approach and consists of stages 1 and 2. (Figure 1) The goal of stage 1 is to eliminate hazard. This is achieved by taking actions to change the design, and to substitute materials. The goal of stage 2 is to establish a balanced process, which reduces risk to an acceptable level. Actions to meet this goal include engineering control, awareness, safe operating procedures, training, and personal protective equipment to name a few.

![The 2-Stage Approach to Reducing Risk](image)

**Figure 1: The 2-Stage Approach to Reducing Risk**

**A Case Study involving Risk Assessment**

The following is an example of how risk assessment could have been used proactively to prevent a lost-time accident in a manufacturing plant. On February 29, 2008, production was about to go down for the weekend at this XYZ company (company name withheld for confidentiality purposes) which manufactures food products. The last 40 lb-bag of food product from the production line was making its way to the packaging equipment unit when it was caught at a transition point between two conveyors. This was due to the fact that the transition rollers between the conveyors are freewheeling (non-driven) rollers. (Figure 2)
The maintenance mechanic noticed the stationary bag and decided to use his hand to push it over the non-driven rollers in order to allow the bag to continue on its travel. The mechanic succeeded in pushing the bag over but the forward movement of his hand towards the direction of movement of the conveyor caused his right hand to be caught between the moving conveyor belt and the free-wheeling roller. As a result, the back of his right hand suffered a complete skin abrasion of approximately nine square inches (9 in²) on the back of his right palm although there were no fractures. The mechanic was immediately transported to a nearby hospital emergency room, where he was treated and released. The accident resulted in a total of two months of lost work days, including three surgeries to repair the damaged skin. The mechanic came back to work on April 28, 2008 with medical restriction to a weight limit of 20 lbs on the affected hand.

Now, the question is why did this accident happen? Several factors can be identified. First of all, the mechanic did not use the proper lock-out procedure or isolation of energy before putting his hand on a moving conveyor, especially when the lock-out point was only about 12 inches away from the accident point. (Figure 3)

Secondly, the mechanic chose not to step on the ladder stationed at the place of the accident, knowing that the conveyor is about six feet high from the floor level. Third, the mechanic did not use the “6th finger”, which could be any piece of object such as poles, broom-stick, etc., to push the bag over the non-driven rollers.

Based on these three contributory factors, one may conclude that this incident was negligence on the part of the employee. However, is that right? What about those engineers or technologists who designed this equipment? Didn’t they foresee this jamming issue? Some of the preventive measures in this incident may include the installation of safety guards, which could be fixed guards, interlocked guards or other devices such as photoelectric sensors to protect any incident at this particular location or section of the conveyor.
Proper training on lockout tag out procedures is another preventable measure. There is so much to be accomplished with training. Although we cannot prevent every intentional move but there are so many things companies could do to help eliminate these types of accidents. For example, just because we train our driver to drive safely does not necessarily mean we should remove airbags, or even seatbelts from automobiles. Those are protective measures or equipment to protect an individual(s) should an accident occur. At the same time, this does not necessarily mean that the company should place protective guards everywhere in the plant. A solution would be the utilization of Risk Assessment to identify hazards and to remove or reduce the risk using the processes described earlier in this paper.

The plant management, other responsible individuals, or preferably the safety committee which is usually made up of some members of the management, engineers, operators, and safety professionals within the organization could have identified these hazards and evaluated the probability and the severity using risk assessment matrix. (Table 1) Possible ratings on the Risk Assessment Matrix would be extremely high risk, high risk, moderate risk or low risk, which are described as follow:

- **Extremely High Risk**: Unacceptable levels of risk, including catastrophic and critical injuries that are very likely to occur. Organizations should consider whether they should eliminate or modify activities that still have an “E” rating after applying all reasonable risk management strategies.
- **High Risk**: Potentially serious risk that is likely to occur. Application of proactive risk management strategies to reduce the risk is advised. Organizations should consider ways to modify or eliminate unacceptable risks.
- **Moderate Risk**: Some level of risk that is not likely to occur. Organizations should consider what can be done to manage the risk to prevent any negative outcomes.
- **Low Risk**: Minimal risk and is unlikely to occur. Organizations can proceed with these activities as planned.
Possible ratings for PROBABILITY would be frequent, likely, occasional, seldom and unlikely, which are described as follow:

- Frequent – Likely to occur immediately or in a short period of time in the life of a system.
- Likely – Occurs several times in the life of a system.
- Occasional – Sporadically occur and will occur in the life of the system.
- Seldom – Not likely to occur but can be expected to occur in the life of the system.
- Unlikely – Very rarely or unlikely to occur in the life of a system.

Possible ratings for SEVERITY would be catastrophic, crucial, marginal, and negligible, which are described as follow:

- Catastrophic – May result in death, or permanent disabling injury, damage to property.
- Critical – May cause severe injury, occupational illnesses or major system damage.
- Marginal – May cause minor injury, minor occupational illness or minor system damage.
- Negligible – Hazards presents a minimal threat to safety, health and the system.

For example, after the discussion about the state of the existing hazard and the rate of probability of this incident occurring is Occasional, the group will now be required to determine the severity of the scenario, or what the severity would be if someone accidentally puts his/her hand into the gap between the conveyor belt and non-driven rollers of the conveyor. The severity may be rated as critical because of the possible consequences such as losing body parts or laceration, which could lead to pain and lost workdays. After determining both probability of Occasional, and severity of Critical from the table in Figure 4, the group can conclude that this scenario or section (the gap between the conveyor belt and non-driven rollers) of the conveyor would fall under High Risk level in the table. Once the group has identified which risk category this event falls under, the company could take proper action to prevent possible injuries or fatality.

From the above example, if Occasional probability and Critical severity were found to be high risk, then the company should have placed some sort of guards at that particular location. Conducting and retaining a documentation of this risk management process would show initiative taken by the company and it could become a sales pitch while protecting the company should someone start litigation against the management. Many injuries, such as the one described above could have been prevented if companies will conduct risk assessment of the processes and equipment in their manufacturing plants.

Table 1: Risk Assessment Matrix

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<tr>
<th>SEVERITY</th>
<th>PROBABILITY</th>
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<td>FREQUENT</td>
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<td>NEGLIGIBLE</td>
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Conclusion
In industries, Health and Safety must be the overriding priority above all other things, including quality, sanitation and production. Experience has shown that most managers verbally rank health and safety as the number one factor in their daily operational activities and much more are needed to translate it into practice. Good employers regard their employees as their best assets therefore their health and safety must be guaranteed.

As you can see from the background information on the lean concept to the case described, it became apparent that safety can never be overlooked. In order to have a productive working environment, each company will need to provide safe and healthy working environment for the employees. Injuries and death do not cause only pain and suffering to individual but also are sources of waste in manufacturing plants. These sources of waste just like accidents can be avoided or controlled to a minimum. By utilizing risk assessment process, a company can achieve minimum risks while minimizing waste. Risk assessment technique can also be applied to other various situations and processes in the industries.

Bibliography:


Biography:

Dr. SHOJI NAKAYAMA is an Assistant Professor of Organizational Leadership and Supervision in the Department of Construction Science and Organizational Leadership at Purdue University Calumet. He teaches safety and health related courses, and has environmental, health and safety related experience in automotive, airline, regulatory agency, printing industries, and telecommunication.

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