



# Lean Influence on Occupational Safety and Health in Manufacturing Industries

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# Lean Influence on Occupational Safety and Health in Manufacturing Industries

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**Abstract-** This paper attempts to investigate the influence of lean thinking on occupational safety and health problems improvement in manufacturing industries and it also to show how occupational safety and health severely hurts manufacturing industries productivity. Nowadays, developing countries are focused on Technology Transfer and be engaged in developing their manufacturing industries so as to compete globally and for their economic growth. While expanding the development of their manufacturing industries, they are also importing new technologies with which they are not familiar and furthermore, neglecting workplace safety and health hazards impact on productivity and workers well-being. Due to these reasons, much productive working time is lost and high costs have been incurred. To highlight the impact of lean on workplace safety and health, this study was conducted by reviewing recent state-of-the-art literature and taking into consideration secondary data records from Ethiopian Ministry of Labor and Social Affair (MOLSA) for simple illustrative example. Findings from the literatures showed that there is less attention and consideration of lean workplace safety and health in manufacturing industries. The data analysis of illustrative example revealed that there are losses of productive working days, high compensation costs and costs associated with many non-value adding activities. This analysis showed that the Ethiopian manufacturing companies do not have the level of awareness how lean occupational safety and health cuts these costs using lean tools like 6S. Hence, this study forwarded how lean helps to improve workplace safety and health in manufacturing industries.

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## I. INTRODUCTION

Nowadays, organizations compete between themselves in various categories such as faster delivery, price tags, state of art technology and higher quality dimensions [Sharma, 2012]. Ethiopian manufacturing industries are given priority of development by Ethiopian government (Web-1). Ethiopia is in a very fast manufacturing industrial development. In the process of industrial development, workplace safety and health problem are issues that have to be squarely addressed.

In manufacturing industries, there are many problems that occur at workplace. Industrial development creates more employment and requires more usable technologies either new or obsolete. This

may lead the manufacturing industries to entertain hazards unless otherwise enterprises devise protective methods of hazards. A large body of existing empirical data analysis shows that industrial accidents focused more on manufacturing and construction sectors (Saad et al, 2012). One of the methods that enable manufacturing industries to reduce those industrial hazards is lean thinking philosophy.

Lean is the method of reducing non-value adding activities in the manufacturing industries (Alireza, 2011; Kilpatrick, 2003, Spencer, 2007). Workplace safety and health hazards improvement helps the manufacturing industries to reduce wastes like time when an employee gets absent, compensation cost of unsafe employee and waste from damaged manufacturing equipment & tools. Documents obtained from Ministry of Labor and Social Affair (MOLSA, 2012) report justifies that most Ethiopian manufacturing industries still have no concern of workplace safety and health matter as their company's critical issue of productivity affecting factor. Hence, lean occupational safety and Health (OSH) is one of the techniques that reduce workplace hazards and risks if properly thought in manufacturing industries.

The importance of work place safety and health hazards improvement is not a questionable issue in the eyes of professionals and researchers' area but, the concern is on how to control its severity from its risks. As studies showed that many researches have not been conducted on lean Occupational Safety and Health (OSH) considering how to reduce or eliminate non-value adding wastes from manufacturing industrial sectors. In general, many studies agreed that developing countries have conducted few researches on OSH overall concerns. In order to run intensive studies and continual workplace safety and health improvement, management and society awareness creations are key elements. In developing countries, top managements have neglected workplace safety and health impacts on productivity and health though developing countries have cheap labor forces.

In 2012, as illustrated in this study, all Ethiopian manufacturing industry (excluding Addis Ababa, Tigray and Southern parts) has registered a total accident number of 1670 and had significant cost hazards to the manufacturing industries, indirectly to the economy of the country. The time lost during the same year was 11,138 man-days. The accident severity rate of

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manufacturing industry in Ethiopia was calculated as 0.075. This means every individual from her/his 1000 of working hours wastes 0.075 man-days. However, this is used only to show the severity of accidents occurred in the only considered regions. It raises a question of unreliability of well-organized data report obtained from all inclusive manufacturing industries. Had it been registered appropriately, the accidents registered would have been increased (MOLSA, 2012). Therefore, these researches provide insight how lean workplace safety and health improves and reduce ineffective manufacturing workplace safety and health management through 6 S techniques. It also becomes the only study that is attempted in Ethiopia in such a way that it introduces lean workplace safety and health problem solving culture as well as helps to other researchers in providing well organized information on lean safety. This study remaining works are structured as follows: section two focuses on methodology how the article was prepared. Section three discussions on the literature review of occupational safety and health and lean manufacturing. Section four discusses on the results and discussion parts and last section discusses on conclusion.

## II. METHODOLOGY AND MATERIAL

The research was conducted by considering two sources of data: (1) from literature review and (2) from data records of illustrative example of Ethiopian manufacturing industries. A literature search was conducted using the databases source like MEDLINE, Emerald, Taylor & France publications, EMBASE (medical literature), PsycINFO (psychological literature), Sociological Abstracts (sociological literature), Accident prevention journals, US Statistics of labor, European Safety and Health database, ABI Inform, Business Source Premier (business/management literature), EconLit (economic literature), Social Service Abstracts (social work and social service literature), Lean thinking databases. The search strategy was also focused on articles or reports that measure one or more of the dimensions within the research OSH model framework. This search strategy was based on a framework and measurement filter strategy developed by the Consensus-based Standards for the selection of health Measurement Instruments. The search strategy also utilized important keywords related to OSH and lean. Controlled vocabularies were used whenever possible. Data from Ministry of Labor and Social Affair (MOLSA) was also collected and were presented for illustration. Data regarding Ethiopian manufacturing industries accident and insurance premium cost were also taken into account for this study approach.

## III. LITERATURE REVIEW

Nowadays, work place safety is considered by World Health Organization (WHO) a priority setting for

health promotion in the 21st Century [Takala, 1999; WHO, 2010]. In order to bring an accelerated sustainable economic and social development, a country needs to have health and safety certified workforce to improve productivity. Workplace safety and health impact is one of the main driving economic and social development pillar factor. Previously, it was given less consideration due to the fact that the focus was on the short term profit of business than safe workplace consideration. Thus, workplace safety and health was given less courtesy for a long period of time. International Labor Organization (ILO) and WHO reports indicated that in manufacturing industries many employees suffer from workplace injuries and property damage resulted in economic crisis [ILO,2010]; WHO, 2010]. Safe workplace and safe work is necessary for reducing those suffers and increasing productivity; hence promotion and protection of safe work and workplace is the complementary aspect of industrial development [Takala, 1999]. In Sub-Saharan African countries about 54,000 fatal and approximately 42 million occupational accidents happen annually that results at least 3 days absence from work of every workers [Tetemke et al., 2014].

The ILO has estimated that the total costs of such accidents and ill health amount to approximately 4% of the world's Gross Domestic Products (GDPs) [ILO, 2006; Kharbanda and Stallworthy, 1998]. Limited financial resources and lack of adequate data has hampered the efforts to combat the problem of industrial and occupational accidents in developing countries [Kharbanda and Stallworthy, 1998]. This is not only hampering but also hindering knowledge transfer and implementation of OSH management techniques.

Hence, lean workplace safety and health study have been conducted in this research. Lean manufacturing is one of the most important techniques that reduce wastes of manufacturing industries (Alireza, 2011). Among many factors that cause waste to manufacturing industries is less consideration of occupational safety and health hazards impact on manufacturing industry environment. Lean manufacturing concepts were first introduced by Womack et al. (1990) aiming to describe the working philosophy and practices of Toyota, the well-known Japanese vehicle manufacturers. Nowadays, Lean Manufacturing concepts are widespread all over the world in different industrial sectors (EPA, 2000; Aitken et al., 2002; Aberdeen Group, 2006). Lean Manufacturing (LM) hence, refers to a business productive operation. It leads to boost the morale of the concept wherein the goal is to minimize the amount of time workers loss, promoting a sense of pride in their work and resources used in the manufacturing processes and ownership of their responsibilities and increases other activities of an enterprise. Its emphasis is on organization's profitability and competitiveness in the eliminating all forms of

wastage. A key to worker safety in LM operations is the previously separated exposures and this has additive and development of informed, empowered and active workers cumulative effects (Alireza Anvari, 2011). Lean identifies waste/Muda (overproduction, waiting/idle time, unnecessary transportation, non-value-added

processing, unnecessary stock on hand/excess inventory, motion and efforts, defects/producing defective goods, unused creativity) [Kilpatrick,2003, Spencer, 2007]. The evolution of lean thinking in any manufacturing industries is shown in Table 1.

Table 1 : The evolution of lean thinking [Liker, 2004]

	Period on Development of Lean Thinking			
	1980-1990	1990-mid 1990	Mid 1990-1999	2000+
Focus on approach	Production cell and line Highly prescriptive, using lean tools	shop -floor Highly prescriptive, imitating lean organization	Value streaming Highly prescriptive, applying lean principle	Value system Integrative, using different management instrument
Industry sector	Automotive vehicle assembly	Automotive-vehicle and component assembly	Manufacturing in general –often focused on repetitive manufacturing	High and low volume manufacturing, extension into service sectors
Typical activity in this phase	Application of JIT technique, 5S, kanban	Emulation of successful lean organizations training and promotion, TQM	Improving flow; process based improvements, collaboration in the supply chain	Improving customer value to improve organizational alignment , decrease variability

As seen in Table 1 lean evolved through different improvement and thinking approaches. As the time of development and human being creativity increases from time to time, lean thinking come to value streaming approaches. These in turn helped industries to focus on customer value and decreased variability.

Lean safety is the creation of a lean workplace safety and health environment in a workplace that requires employee motivation and good management (Alireza, 2011; Gnoni et al, 2013). The same study attempted to discuss 6S (Sort, Set in order, Sweep, Standardize, Sustain +Safety), is the foundation for all improvement programs: waste reduction, cleaner and safer work environment, reduction in non-value added time, effective work and visual workplace vision. The intensification of work leads both to higher plant productivity and to great adverse ergonomics and stress related health effects to workers (Brown, 2007).

Hazard are categorized as health and safety hazards: where health hazard causes occupational illness such as noise- induced hearing loss and safety hazard cause physical harm like cuts, broken bones and so on (Alireza,2011). The major factors in the creation of hazards in companies are: employee demotivation, lack of or unclearly defined working procedure and tasks, lack of control, lack of instructions or appropriate training, unsafe worker behavior, low management commitment to safety, no consensus on what a Safety Management System (SMS) exactly is and on the corresponding scope [Manitoba, 2003, Chan, 2004]; all these can be controlled in LM environments (Alireza, 2011).

Employee safety is a value-added proposition and by taking a Safety-Integrated Process Improvement approach, organization will be able to manufacture

products and/or deliver services faster, better, cheaper, and safer.

Table 2 : The value of Safety

Traditional view of safety	Transition	Safety integrated leans
Cost-saving venture	➡	Process improvement opportunity
Injury/ illness cost Insurance cost Regulatory cost	➡	Process knowledge Sharing information Problem solving
Cost benefit analysis	➡	Value –added vision
“what is important about safety is what it costs”	➡	“what is important about safety is what we lean”

Table 2 clearly shows the difference between traditional views of safety and safety integrated leans. Traditional safety view is all about cost and injuries while the integrated safety eyes all about process improvement and value adding process.

In general, accompanies' those introduce and practice lean thinking would get benefits like decreased lead times for customers - productivity improvement, reduced inventories for manufacturers- work-in-process, inventory reduced, improved knowledge management/increase process understanding, more robust processes (as measured by less errors and therefore less rework)- quality improvement, reduce Space utilizations, save finances, improve process and easy works (safe working environment) (Melton,2005).

IV. RESULT AND DISCUSSION

By integrating safety and health problem solving methods into continuous improvement process, company will decrease costs, lessen downtime, reduce errors related to safety and health hazards, apply safety metrics to value stream mapping (VSM) for process improvements, identify and assess safety waste in processes, work collaboratively and cross-functionally to develop lean and safe solutions, be able to develop return of investment metrics utilizing results of safety-integrated process improvements, sustain improvements, lead a lean and safe organization, improve safety within company and increase company morale. A comprehensive study conducted by Francie Lund and Anna Marriott (2011) would suggest that globalization is having a negative impact on OHS. Hazardous industries have increasingly been transferred to developing countries where there are fewer resources to protect workers (Barten et al. 1996) or where, in some cases such as export processing zones, employers may be exempt from labour legislation (Brown 2004). New global production methods such as Just-In-Time, Lean Production and Total Quality Management have also been associated with greater levels of musculoskeletal disorders and repetitive strain injuries that are caused by repetitive motion, static and/or awkward postures and manipulation of heavy weights (Brenner et al. in ILO 2004). However, since examples of positive effects also found in literature, it is important to move from a simple cause and effect model to a more comprehensive that understand lean as an open and ambiguous concept (Peter et al., 2012). Elimination of waste can also be interpreted as the elimination or minimization of risk that adversely affects wasted human resources and lost time from injuries.

Lean imperatives of faster, better, and cheaper must encompass the issue of running safer as well. A key to worker safety in LM operations is the development of informed, empowered and active workers with the knowledge, skills and opportunity to act in the workplace (5S) to eliminate or reduce hazards [Alireza,2011].

For instants, let us consider illustrative example for Ethiopian manufacturing industries accident registered. Figure 1 shows that the accident registered over 13 years (from 2000 to 2013) in industrial sectors. This data report is used to show the severity of accidents and their economic influence on Ethiopia manufacturing industries. The industrial sectors were more exposed to accident when compared to other sectors (MOLSA, 2012). GTP volume II of the country direction is also on manufacturing industries lead economy. In line with the manufacturing industry development the employment rate also increases. When there is more demand of new employees who are not familiar with workplace environment, they commit and

receive more accident severity in this sector (Saad, 2012). Hence, it is easy to foresee the rate of increase of accidents in manufacturing sector.

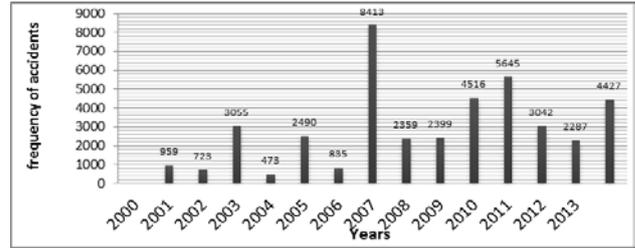


Fig. 1 : Workplace accidents in Ethiopia (MOLSA, 2012)

A data obtained from MOLSA shows us that workplace accident is a very serious issue in Ethiopian manufacturing sectors. Manufacturing sectors comprises 2723 organization in Ethiopia and only 5.3% of them have established OSH committee in their own industries. 95% of the manufacturing sectors have no OSH committee that carries out follow up activities of their workplace safety condition. The data obtained from MOLSA, for instance produce 0.075 accident severity for manufacturing industries (Eqn. 1).

Severity of the accident =

$$\frac{\text{work days lost by accident} * 1000}{\text{total working hours} * \text{total employees number}} \text{ ----- (1)}$$

$$(11,138 * 1000) / (2476 * 59857) = 0.075$$

As the data record obtained from MOLSA (2012) record reported that 2476 employees exposed to accidents, 11,138 lost working hours with over all registered total workers of 59,857 (excluding Addis Ababa Administration, Tigray region and Southern region) of manufacturing industries. of the total lost working days, manufacturing industry has 0.075 severity of the accidents index. This means in each individual working hour of 1000, there is a lost working day of 0.075 due to workplace accidents. If it had included Addis Ababa, Tigray and Southern part of Ethiopia where there were more manufacturing industrial zones, there would have been amplified industrial accidents and lost working hours. In manufacturing industries, there are 13,874 employees during 2012 of 59,857 employees from around urban industrial sector information. These data record are not representative of the reported regions. However, it helped us to show how much the severity of the accidents in manufacturing industries even There was poor data management system. This poor data recording culture is true in many developing countries as studies have described the lack of data recording and management system. Data recording and management system in developing countries are being underreported (PaiviHamala inena et al., 2006). The clear lack of reliable and large-scale data on OSH risks in developing countries and for informal workers in particular highlights the need to invest more resources in OSH and development research (Francie Lund and Anna, 2011).

Therefore, lean manufacturing philosophy is the best method that reduces this more working day's loss and non-value adding activities cost to the manufacturing industries even though many studies put its negative impact on safety.

#### *Why Lean OSH?*

To eliminate workplace hazards and waste of materials and resources, workplace organization, cleanliness, and standardization are imperative. The 5S approach is highly effective at removing hazards and waste from workplace and creating a safer, cleaner, and healthier work environment. Simple techniques are used to develop and improve effective workplace organization, safety, visual communication, and general cleanliness and housekeeping. Implementing 5S to workplace helps to bring the following benefits.

**1S – Sort:** Identify the items that are needed to perform work in the work areas. Clear (sort-out) all other items from the work area. Its benefits are extra work space, improved safety, improved productivity, improved utilization of materials, supplies, and resource, more visible work flow, improved employee satisfaction (better place to work) and improved quality. **2S - Set In Order:** All needed items have a place in the work area and each needed item is in the correct place. Improve ease of or need for retrieval. Its benefits are elimination of time, motion, and effort needed to search for or retrieve tools and supplies (tools and supplies are located at point of use), improved safety through an organized workplace and increased productivity. **3S – Shine:** Proactive/preventive housekeeping to keep work areas, work surfaces, and equipment clean and free from dirt, debris, oil, etc. its benefits are cleaner and more satisfying place to work, improved quality, maintenance issues exposed faster (planned downtime vs. unplanned downtime), and improved safety (fewer accidents). **4S – Standardize:** Do things in a consistent and standard way. Standardize activities, procedures, instruction, schedules, and the persons responsible for helping keep the workplace clean and organized. Standardize work area layouts and storage techniques wherever possible. **5S – Sustain:** Integrate 5S principles into the organization's OHS in order to sustain new standards and continually improvement of the workplace. **6s-safety:** it is better than 5s in considering the accidents at work place and saving the life and property damages. So, it integrates the 5s into the lean OSH organization. It is known also as 5S Workplace Organization + Safety. Why add safety to make 6S? It creates greater awareness, more focus and another chance to review. Hence, using 6S helps organizations to make Zero accidents and/or Zero near misses.

## V. CONCLUSION

Many researches have been conducted on lean manufacturing benefits and tools, and they have agreed

on lean safety positive and negative influence. However, other researches strengthen that the positive effect of lean safety is taking highest share. In the literature, it has been discussed that in many countries, occupational safety and health management is not the critical issue of manufacturing industries. But, some literatures argued that workplace safety and health is one of the world issues of health and wealth. Most literature discussed that to be successful in productivity improvement; one is lean workplace safety and health in manufacturing industries.

These researches output provide highlight how lean workplace safety and health improves and reduce ineffective manufacturing workplace safety and health management through 6S techniques as discussed in literatures part. It also becomes the only study that is attempted in Ethiopia in such a way that introduces lean workplace safety and health problem solving culture and helps other researchers in providing well organized information on lean safety.

Illustrative example of Ethiopian manufacturing industries accident data has showed that how workplace hazards incur cost and waste of time to the companies. The days lost and the costs paid to the employees as compensations were all wastes of the manufacturing industries in which they were non-value adding activities. Therefore, the companies are considered to exercise lean occupational safety and health so that they can reduce their workplace wastes and increase productivity of their manufacturing industries. The concepts of lean manufacturing industries are also very important to be exercised in manufacturing industries in controlling and managing workplace hazards. Moreover, the researchers recommend while Ethiopian manufacturing industries focus on their development strategy, they should also give due consideration workplace safety, employee well-being and equipment safety so that they can easily raise their productivity and be globally competitive.

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