APPROACHES TO INDUSTRIAL SAFETY

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ABSTRACT
The earlier age of safety management during the industrial revolutions reveal that most accidents were due to failure of technology, not because the equipment were entirely faulty but to the lack of importance given to the probable risks involved due to man-machine interface. The limitations of appropriate safety gears for the carrying high risk jobs is one such example. Studies of accidents in manufacturing industries reveal that majority of the accidents are caused by equipment failures and the other major frequent causes are human error, work methods, training and poor maintenance. The overview of the safety environment in the last 100 years reveal the various approaches adopted for safety management from traditional approach to today's people based approach. The probability of a worker being killed in an industrial accident is less than half of what it was 50 years ago. Improvements in safety until now have been the result of pressure of legislationspromoting safety and health, the steadily increasing costs associated with accidents and injuries,and the professionalization of safety as an occupation. Improvements in the futureare likely to come as a result of greater awareness of the cost-effectiveness and resultantcompetitiveness gained from a safe and healthy workforce.This paper examines the historical approaches to and howit has developed over the years. Today not only the fatal accidents are more of a concern for safety professionals but also the minor non-fatal accidents which if not managed effectively could result in a major cause of concern in the future. Behaviour Based safety approach is still in the crux of various dimensions of safety management process today. Behaviour based safety though started based on the crux that managing human behaviour results higher safety performance, but today it has become more holistic in its approach involving all the stake holders and systems along with human behaviour to manage safety at workplace.

Introduction

Industrial Safety is predominantly a scientific process of identifying and eliminating the workplace hazards, addressing the risk associated with the hazards and ensuring the safety of employees and the industry in general. Today the term Occupational Health & Safety has broadly taken over the concept of Industrial Safety. Safety is no longer seen as antraditional Industrial factor alone, it is seen as a multidimensional factor that affects the health & safety of employees in different occupations and overall organizational working environment. Occupational safety and health is today focused on protecting and preserving the employees and the materials at workplace. Concern for Occupational Safety has been an age-old issue with historical references such as code of Hammurabi during 2100 BC. The code focused on personal injury and losses and has prescribed a schedule of punishments and compensation for safety violators(1).The modern safety systems which we take for granted today didn't exist a century ago. Today's employees have better working conditions than their predecessors had. The concept of Occupational Health and safety became a global concern owing to the industrialization across nations. For over 100 years the approach towards safety was focused on developing systems and legislationsmaking the industries accountable to enhance the safety & health conditions and to a large extent the approach has become a global phenomenon.

Global scenario on Occupational Safety and Health

Obtaining a comprehensive global data on Occupational Safety and Health has its limitation. Not all countries have a national level data on work related injuries and mortalities and the available data are obtained from various sources. Even developed countries with well-established accident reporting mechanism, often fail to report all the cases especially with lower severity or non-fatal injuries. According a report by International Labour Organization (ILO) on work related diseases, out of 2.3 million reported fatalities, over 350,000 deaths are due to occupational accidents. Workplace accidents results in death of around 1,000 people every day. There were over 313 million non-fatal occupational accidents in 2010 and close to 2 million death due to work related diseases. In addition to the immeasurable individual suffering, these workplace accidents pose major financial losses to the industrial stakeholders including loss of manhours, productivity, damage to property, compensation and unemployment due to partial or total disablement. As per the ILO report, there is also a financial loss of

around 4% of world's gross domestic product (GDP) due to direct and indirect cost related to workplace accidents and aftermath(**2**).

Global Trend of Occupational Accidents (1998-2014)

Year	Fatal Occupational Accidents		Non-Fatal Occupational Accidents (atleast 4 days of work absence)	
	Number	Rate[a]	Number	Rate[a]
1998	3,45,436	16.4	26,36,21,966	12,534
2001	3,51,203	15.2	26,80,23,272	12,218
2003	3,57,948	13.8	33,65,32,471	12,966
2008	3,20,580	10.7	31,74,21,473	10,612
2010	3,52,769	11	31,32,06,348	9,786
2014	3,80,500	11.3	37,39,86,418	11,096

Rate[a] -Number of accidents per 100,000 persons in the Labour force
(**Source:**Global Estimates of Occupational Accidents and Work-related Illness 2017(3))

Approaches to Safety Management

Today in the era of artificial intelligence, employees take personal safety as a matter of rightand to a large extent are aware of the safety provisions and people prefer to work in organizations that ensures workplace safety. If we recollect the situation of workers of the past, the plight of workers at the beginning of the industrial age and during the industrial age was very pathetic. Mortality associated with construction, mining and manufacturing industries was an acceptable norm of industries.Employing children below 10 years old in hazardous work environment was also a normal business practice. One of the earliest counts of largest disaster was the Halifax explosion caused due to the collision of SS Montblanc laden with explosives with another relief vessel SS Imo in Canada. The explosion killed around 2000 and injured another 9000 people including the crew of the ships, harbour workers and people in the vicinity of the explosion (**4**).

Safety Management has evolved over the century and so has the approach towards safety. The various approaches towards the Safety Management are discussed in this paper.

Traditional Approach

The traditional approach towards safety during the Industrial Revolution era focussed on preventive measures to protect the employees from the harm's way. It was considered that failure of technologycaused accidents resulting in injuries to people. Industrial process started replacing human efforts, mechanised ways of dealing with raw materials were introduced and focus was on specialization of work resulting in division of labour. Safety was perceived as industry specific phenomenon. Mining, Rail Transportation and manufacturing were considered the most hazardous occupations of the time. Companies paid higher wages to high risk jobs. Workplace accidents did not affect the bottom line, as victims of industrial accidents were at the mercy of the employers when it comes to compensation(**5**). With the implementation of compensation laws in US and Europe, employers had to shell out more on the treatment and compensation towards injured workers. Focus towards safety was considered as strategy to reduce the compensation costs. With industrial reforms also on the rise, industrial safety become employer's responsibility.

Regulatory Approach

With the rise in Industrialization, the safety challenges posed by technology had to be addressed and the rising demands of social reforms to regulate the safety mechanisms for larger welfare of the industrial workers. United Kingdom was one of the pioneering countries in bringing regulatory approach towards Safety standards at work. Health and Morales Apprentice Act was passed by the parliament in 1802. The act was instrumental in regulating the working hours of pauper children to 12 hours, mandatory accommodation and clothing, ventilated and hygienic work environment. It was followed by the Factories Act of 1844 which provided higher standards of Safety and significant role for factory inspectors to govern the provisions of the act. More acts were passed during the following years to govern industriesspecific to mines, quarries and explosives. United States also experienced safety reforms during the same period. The legislators of Massachusetts were the first to enact the nation's first Safety and Health Legislation in 1877. The law prescribed mandatory safety measures such as guards for belts, shafts and gears, and adequate fire exits. By 1890, nine more states followed by implementing similar standards of safety. Real progress came in the form of Safety Appliance Act in 1893. The globalization

of regulation of safety standards rose to higher levels so did the number of accidents post world war I & II. Industrial productions grew to greater heights so did the number of accidents and its complexities. By 1960's 14000 workers were killed and around 2 million disabled due to industrial accidents. Occupational Health and Safety Act was passed in USA in 1970 and Health and Safety at Work act was passed in UK in 1974. The legislative approach brought in higher safety standards to protect the workforce but did not bring down the workplace accidents to acceptable levels.Internationally these increasing concern for safety standards culminated in the introduction of the International Labour Organization convention on Occupational Health and Safety, ILO Convention 155 - Occupational Safety and Health Convention (1981), Geneva, which was adopted on 22 June 1981(6). The safety legislations in India were in line with the UK legislations as India was under their rule during the earlier industrialization period in the pre-independence era. Post-independence the major acts which focused on industrial safety were Factories Act 1948 and Mines Act 1952.

Organizational Approach

Though strict standards of Safety had evolved following the legislative approach, the whole-hearted participation of organization was still at the periphery level with priority given to production and higher profits. But this profit motive of industries also led to organization leadersto focus on loss preventions as a strategy to maximize the profits. Organizations were motivated to look at the accidents control systems to reduce the accidents.This gave rise to the organizational approach to safety management. This approach was quite successful because of its alignment to the organization goals. Organizations could associate the cost attached to the accidents including the cost associated with human life. Organizations identified the costs attached to the failure to comply with the statutory requirements and cost linked to the compensation and insurances coverage. The approach was top management driven with safety professionals with very limited employee participation. It was more a protective approach with little authority to safety professionals to deviate from the management guidelines and focussed on employee discipline and centred on technical requirements (7). Safety professionals were employed more as a compliance/regulatory supervisor by the organizations. Safety Management was seen as a legal responsibility of organization to provide a safe working environmentas well as a strategy to focus on the work-based safety management systems which can influence the organization profit margins.The number of safety accidents have been controlled with this approach so was the control of repetitive incidents. But as the businesses embraced the innovative and advance manufacturing processes, the nature of accidents also varied, hence need for continuous improvement of safety management was felt by business leaders. Safety management has evolved over the past several decades and with each stage of development the overall approach and performance of safety standards has also changed.

Behaviour Based Approach

Behaviourbased approach to safety is not something new in the field of Safety. In fact,through the enactment of laws and punishing the people involved in unsafe acts by itself is the process of influencing the psychology of the individual be it the employer or the employee at workplace. Behaviour based Safety (BBS) can be described as the application of behavioural science in managing the Safety related issues at workplace. It also involves application of research-based techniques while handling safety issues at workplace(8). Herbert William Heinrich, the American industrial safety pioneer's book "Industrial Accident Prevention" is considered to be the first published work focusing on Behavioural Based approach to Safety in 1931. The book highlights that only 10% of industrial accidents and occupational diseases were caused due to the unsafe working conditions, while 88% of them were a consequence of unsafe behaviour of employees(9).Post Heinrich it was Dr.Beth Sulzar-Azaroff'sarticles in the Journal of Organizational Behaviour Management in 1978 which spoke in great deal about the importance of behaviour based safety. With regard to the origin of the term Behaviour Based Safety (BBS) there is debate on the credit. Scott Geller, Dan Peterson and Gene Earnest's work on behavioural safety are some of the noted contribution towards behavioural based safety approach(10).

Behaviour based approach to safety does not eliminate the fact that there are technological and environmental factors at workplace that may cause accidents. Safe working environment is not a single factor process but a result of a multifactorial approach. Behavioural Based Safety (BBS) focuses on the psychological factor that motivates and reinforces human behaviour. The traditional BBS approach was more concerned on the employee's unsafe behaviour. However, other factors such as equipment standards and designs, employee fatigue, blind spots and other risk factors at work place were considered   secondary. Over the last two decades, behaviour-based safety has become more popular safety management approach because of its involvement around the human side of safety. It is designed to modify employee's risk behaviour to safe behaviour using motivation and reinforcement techniques. Behaviour based safety aims at inculcating the safe behaviours by motivating the employees to own and drive the workplace safety process. With the acceptance of behavioural safety, organizations also continued to concentrate on unsafe conditions that influences unsafe

behaviours.Unsafe behaviours are similar to the iceberg which remains hidden submerged and only the superficial factors are visible. This results in missing the major risk behaviours while managing safety at workplace.
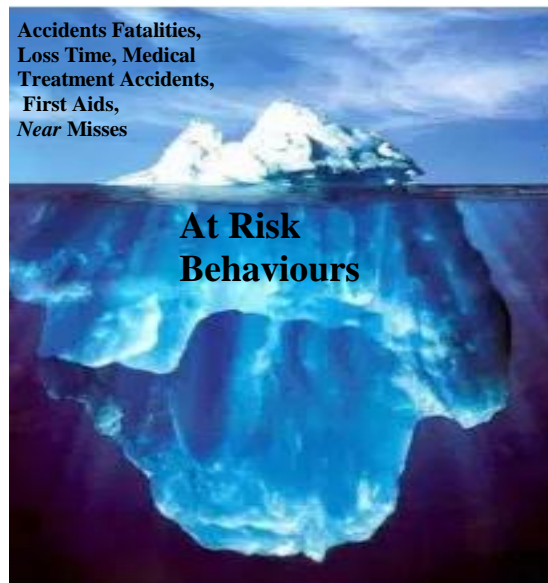
Accident Iceberg**(11)**

BBS is based on the foundation of behavioural principles about engaging, motivating, assisting, reinforcing, and sustaining safe behaviours. Behavioural based safety is about everyone's behaviour, not just the frontline **(12)**. The major psychologists who paved for behavioural theories are Watson (1878-1958), Ivan Petrovich Pavlov (1849-1936), Edward Thorndike (1874-1949) and B.F Skinner (1904-1990). Their studies focused on measurable and observable physical behaviours and manipulation of behaviours through conditioning and reinforcements**(13)**.

ABC Model of behavioural safety is based on the Cognitive Behaviour Therapy by Albert Ellis and earlier works of Operant conditioning by B.F.Skinner. ABC model was instrumental in shifting the focus of problem solving from external environment to internalindividualistc behavioural.

ABC Model of Behaviour **(14)**

Behaviour based safety focuses on working on the antecedents of unsafe behaviours as well as the positive reinforcement practices that motivates individual to exhibit safe behaviours and conform to the safety requirements at workplace.The effectiveness of Behaviour Based Safety is based on the following pillars.

(Source:http://triandmaritime.com/triand-insights/behavior-based-safety/(15)**)**

Leadership: Safety Leadership inspires the vision and values in the organization. The frontline employees visualizes the safety through the eyes of the management. If the Management has positive approach towards safety, the acceptance and accountability level of employees is higher.

Engagement: The vision of management and safety management programs will not be able to take off without the participation of the employees. Their involvement and ownership of the safety programs is the key to success of any safety initiatives. Mostly, it the highly engaged employees who evolve new safety initiatives and innovations.

Coaching: Behaviours need to be constantly monitored and appropriate reinforcements to be given to ensure it becomes habits for employees. Achieving Safety behaviour is not a one-time process, as long as human beings are involved in workplace, appropriate safety training to be given to ensure that employees are equipped with necessary skills to perform a particular task safely.

Communication: Enabling a two way communication between the employees and management and between workforces makes the exchange of safety communication highly effective and productive. Open and transparent communication which includes policies & processes, availability various channels for workforce interaction, feedback from top-down and down-up. Unintimidatedchannels of communication generates positive response from the employees which aids in developing safety behaviour.

Recognition: Any behaviour if not appropriately reinforced through rewards or recognition will lose its sheen gradually. Safe behaviours need to duly recognized and encouraged which enables others to assimilate the same and when more number of employees' exhibit such behaviours it develops a positive safety culture. Recognition not necessary means through rewards only, but may also include simple verbal appreciation in person or public forum.

Measurement: Behaviour based safety needs to be driven based on progressive data derived from the measurement of daily safety performance of the individual and organization. The impact of any safety initiative needs to be measured and evaluated. This quantifying of safety performance leads to proactive approach in safety management. Measurement also assists in giving individual feedback.

Behavior based safety (BBS) emphasizes on employees' ownership of their safe and unsafe behaviours. Both safe and unsafe behaviours needs to accounted, discussed to bring behavioural changes. Employees are key drivers to behavioural change of self and others within the organization.

Behavioural Based Safety focuses on bottom up approach with regard to its application, focussing on the workplace safety behaviours of frontline employees(16). The safety culture of the organization depends on overall safety perception of the frontline employees of the organization. In order to improve safety performance, the unsafe behavioural practices has to be replaced by safe workplace behaviours. To bring in a cultural change, there needs to be both top down approach focusing on organization values and resources and bottom up behavioural change which is driven by the safety leadership.

Challenges to Behavioural Based Safety

Behavioural based safety has its own sets of challenges and may fail miserably as the dynamism of human behaviour is misinterpreted by the people driving the programs at the organization. Unlike hard controls, it doesn't show immediate elimination of risk. If the employees see that the intention of the organization or leadership is to blame the employee behaviour for safety performance of the organization, the entire safety exercise may be quite challenging. Blaming the employee behaviour will not gel down with the employee population.

The safety programs need to be driven by employees and management together. If the employees aren't that engaged with the vision of the organization, the entire approach will remain unproductive. The employees must develop the ownership towards the safety culture. If employees are merely participating in the safety programs as part of routine and there is no pride of being a contributor the safety programs may get diluted.

Another challenge in driving the BBS programs effectively is that nature of reinforcements used to drive the programs. Too much negative reinforcements or too little positive reinforcements end the motivation among the employees and will bring down the engagement levels of the employees.

Conclusion

Occupational health & safety continues to improve globally every year on agreater pace compared to safety environment 100 years back.Today's workplace safety environment cannot be taken for granted. Comparison with the safety environment merely 50 years back reveals the extensive number lives lost due to the workplace accidents and occupational illness. The robust industrial economy today has a history of struggle through the unsafe work environment. The approach towards safety has also changed dynamically from traditional & regulatory approach to people and behavioural based. A lot more scientific and humanistic thinking has gone in developing safety management in today's era.Employee behaviour is not the sole factor determining the safety performance of the organization hence it would be merely an assumption that Behavioural based safety process is the only solution for managing unsafe working environment of the organization. The management should not project Behavioural Based safety as a shield to shy away their safety accountability and governance. Behavioural based safety interventions fail without the commitment and appropriate resources from the top management.

Behavioural based safety has evolved over the foundation based on principles of Psychology, Management and Safety. For the approach to continue to add value to safety performance, the future lies on how effective the channels of feedback, data interpretation, standardization and its integration to the mainstream safety management system. Organizations need to be more holistic in their approach covering all the elements of safety culture and its effects on behaviour of its employees.

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