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Changing Safety Culture through Technology Adoption

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Abstract

In this paper an attempt has been made to highlight the importance of people in management of safety at workplace. Organizations may have commendable policies, procedures, plans and programes but, it is the successful implementation of these ideas which really matters. Successful implementation is not possible without engaging, and motivating the people at Workplace. When people do something only because they have to do it, the success is limited. But when people do something because they feel it is necessary to do and identifies it with their personal value proposition, the picture changes dramatically as it signifies a totally different kind of scenario– a safe working culture within the organisation. Traditionally industries have paid more attention to issues related with compliance to legal and system requirements putting less emphasis on people. As a result the organisations have developed a bureaucratic tendency. This paper argues that a shift toward the people issue alone can bring about the changes in the organisations making it more dynamic and responsive to the challenges of safety management.

A case study has been presented here with 12 large manufacturing companies of eastern India. An attempt has been made to assess the companies' activities in three different areas of safety management - compliance to legal issues, compliance to system requirements and people related issues. This has been examined against their overall safety performance to understand the relationships, if any, among these factors. The outcome of the analysis of data reveals interesting facts. The organizations paying less attention to people issues tend to be more accident prone and show relatively poor results on safety performance inspite of doing comparatively better in the areas of compliance to legal and other system requirements. This finding strengthens and supports the importance of people issue in safety management. The report then discusses different means of people engagement in safety management both at conceptual level as well as its actual implementation. Different approaches are examined like using employee training as a tool to encourage safe practices on shop floor, behavioural based safety and finally the building of safe working culture. Though all these have their usefulness, it is ultimately the safe working culture which stands out as the most potent means to change an ordinary workplace into a safe and healthy work place. Various facets of safe work culture have been examined and a number of suggestions as to how organizations can imbibe a safe work culture have been made. These include adherence to company values, employee empowerment, sound feedback system, communication, consistency in management style etc. Some of the pitfalls in building a safe work culture have also been pointed out. Organisations need to guard against these to avoid common failures in implementing a safe work culture.

Finally it is emphasized that building a safe work culture is the most potent way to develop a safe and healthy workplace in industries in the long run. However, the job is neither easy nor can it be done overnight. It requires meticulous planning and patient execution supported by a committed leadership.

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Introduction

Since beginning of the civilization human being like all other animals on planet earth has struggled for its existence. The prehistoric man had to go in search of food and shelter bare handed aided by his animal instincts alone. In this venture he encountered numerous safety hazards from natural phenomena, climatic conditions and wild animals among others. But mankind due to their superior physical and mental built gradually overcame such barriers, learned new tricks and acquired new techniques which gave them the desired mastery over their environment. In search of a better life men went on innovating which resulted in the industrial revolution in western part of the globe. This was a watershed period in the history of human civilization. It soon engulfed the entire world. With higher productivity and more and more innovative products- quality of life improved, living comfort and longevity also went up and the trend continues. New ideas, innovations and technologies have their spinoffs too. Men and women were exposed to an unprecedented new kind of hazard- the workplace safety hazards. Factories and mines all over the world apart from being a sign of progress also became a source of large number of injuries, ill health and death every year. Such phenomena obviously warrant our strictest attention. Unless we can arrest and reverse this trend and make our factories and mines safe we cannot hope to achieve the much desired sustainable growth. There lies the importance of "Safety Management" in industry. Safety does not happen by chance. It needs to be carefully designed and built into a workplace through meticulous planning and patient execution. The importance of "People Engagement" in this entire exercise is extremely important. In this paper we shall explore this aspect of safety management in greater details.

Traditional approaches to managing safety at workplace

Initially industries have approached safety management purely from the perspective of compliance to legal requirements. With time and maturity came the safety management system perspective and finally the people perspective. The basic features of these three approaches are discussed here.

Regulation led approach: In India a comprehensive legal frame work on safety and welfare of employees working in factories was established by the Government of independent India in 1948. This is known as "Factories act 1948". In pursuance of this act state governments brought out state rules. In combination these are the regulatory framework under which factories in India are expected to function.

Traditionally most of our factories took the position that doing bare minimum on safety to remain compliant to the regulatory requirements and thus avoiding penal actions was enough. The entire approach was reactive in nature. There was no new idea, no innovation. The organization just took a passive position of working in accordance with the rule book. This approach may make accompany compliant to the regulatory requirements but it also makes it complacent to its overall responsibility. It fails miserably in preventing injury and ill health and also fails to inspire the employees to connect with the ongoing safety management system. The overall image of organisations suffered as a result of this. Fortunately things are not so bad today. A lot of new ideas have been brought in the areas of safety management. However, there are some companies in India even today, particularly in the unorganized sectors, which still practice such approach.

System led approach: For a long time organisations were not keen to recognise that safety management system is itself an important part of the overall management system. Safety was left to be managed by the safety professionals. As time went on, management systems started being discussed in India in the form of ILO conventions, American standard OSHA and a host of other publications including the British Safety standards. OHSAS 18001 Occupational health and Safety management system standards were released in 1999. This standard provided a unified approach to safety management system for all kinds of Industries. It became popular and many organisations started implementing OHSAS and getting certified to the OHSAS 18001 standard. The initial response from the Industry as well as the other stakeholders was quite encouraging and lot of positive results were also seen across industries. A feeling, however, was slowly building up and came up for intense discussion. Are we getting the desired benefits from system implementation? It also became increasingly clear that holding on to whatever improvements were initially achieved was proving to be more difficult. For average organisations the focus was very soon shifted to mere certification. The talk was more on documentations, SOPs and audits with much less emphasis on overall effectiveness of the systems and organisations started showing bureaucratic tendencies. Much desired significant improvement in the safety performance was still illusive. The policies procedures and much talked about system

elements by themselves cannot guarantee results. The results depend on successful implementation of systems which in turn is totally dependent on people across the organization at different levels. People by their level of commitments, sense of priority and understanding of the safety management system only can bring the desired change.

People led approach: In this approach

management system giving rise to what is known as 'Safe Working Culture'. People led approach does not replace the system led approach but works in tandem with it to strengthen it further and making it more effective.

1. Regulation led approach

2. System led approach

3. People led approach

Safety performance - maturity diagram
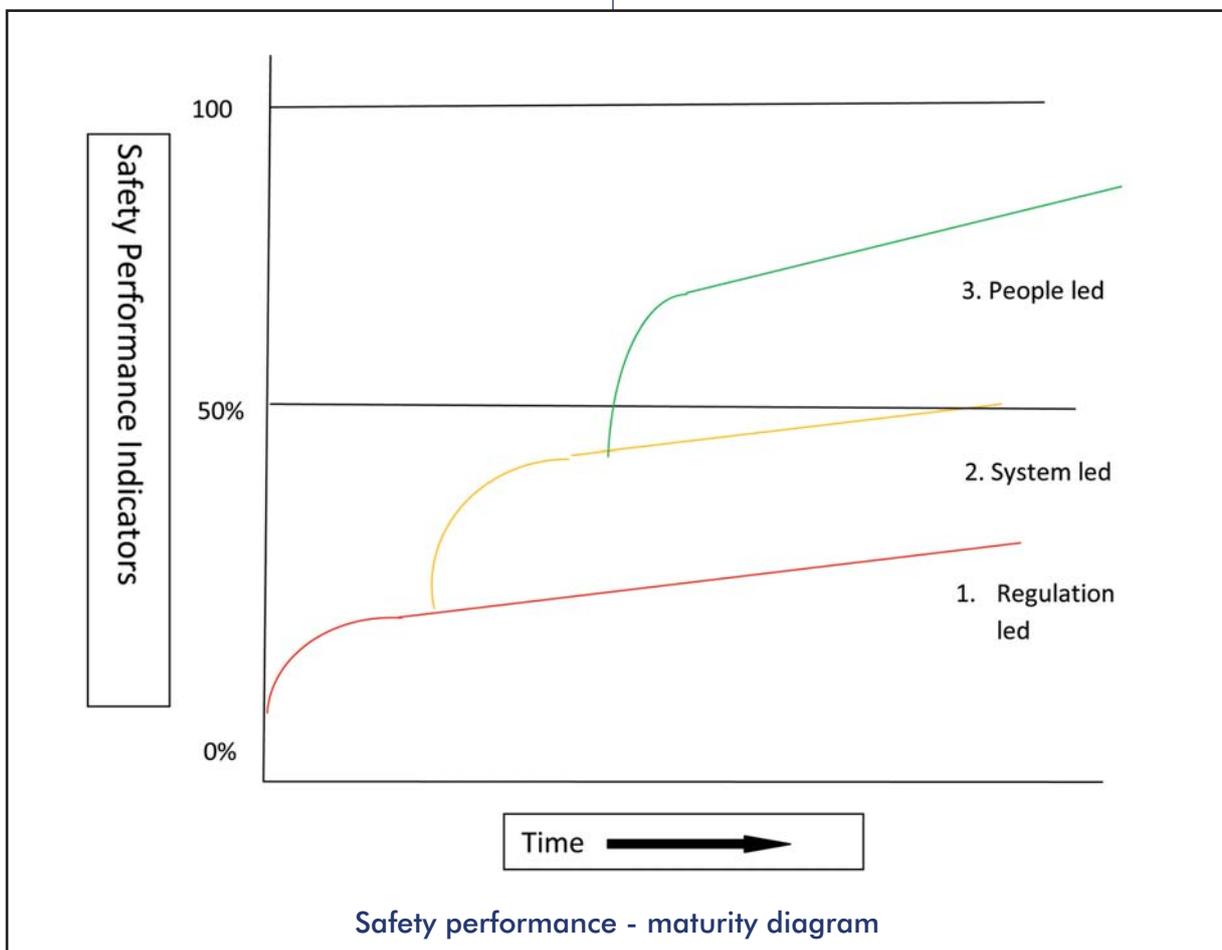
people occupy the centre stage. When people are engaged in a significant way to become a partner in the implementation of regulatory requirements, system requirements, they become an integral part of a safety

The above figure illustrates the theme. Only on the basis of regulation led approach to safety the organizational performance index cannot exceed 30%. But still it plays an important part. It lays down the foundation on

which the system led approach can be established. Without the foundation of a legal compliance, safety management system cannot succeed.

At this stage further improvement can be brought in only by implementing a safety management system. As has been shown in this illustration the combined effect of regulation led and system led approach the performance was improved substantially. However, it still fell short of the expectations.

To overcome the weaknesses of a system led approach, people must be engaged. Only people led approach has the potential to take this performance to greater heights.

The report details this.

The people issue in safety management- the conceptual framework

The importance of people in safety management can hardly be over emphasized. People are associated with the procurement, design, operation, maintenance and shipping in any organisation. Therefore, they are in constant interface with the systems, procedures, and the standards. As a result people are also intimately connected with the successes and failures of those systems. In addition, most theoretical models of accident causation recognise the centrality of people in safety, either as unwitting contributors to unsafe incidents, or important and knowledgeable partners for detecting hazards and preventing unsafe incidents. Safety management system in this sense refers to a

dynamic, emergent state of a system that is able to detect and prevent harm or loss with the active and willing participation of its people in a proactive manner. There are a number of reasons for looking at safety at workplace from a people perspective. At the basic level, all safety management system elements will have four layers:

Structural: The 'structural' layer of a safety management system refer to the formal policies, procedures, and guidelines, objectives, targets that the organisation may have in place to manage safety. In addition, it also includes the adequate hardware, infrastructure, and other resources necessary to implement the safety management system.

Operational: Under 'operational' layers are the activities and practices carried out in the organization so that the systems are actually implemented and integrated within the organisation. This requires that the people are capable of appreciating the importance of capturing and understanding the critical issues of operations. The structural and operational aspects of the safety management system are linked and interdependent. The safety policy and procedures of the organisation must exist before the people within the organisation can implement them. The people within the organisation must be aware of the systems and be sufficiently trained, motivated, and knowledgeable to use it effectively. Both the structural and the operational aspects are heavily dependent on people. With active participation of people, the 'structural' and 'operational' factors could influence the overall safety management performance of the organisation. Systems have to be owned,

assimilated and correctly implemented by people in the organization in order to build a safe workplace. This makes the study of people factor within safety systems even more critical.

Social : This refers to the relationships and interactions between the staff members such as safety managers, incident investigators, front-line supervisors, maintenance technicians, and workers, in performing activities related to safety aspects of the organisation. This also includes interaction between departments, employee groups, suppliers and contractors. What keeps the social factors healthy is the availability of necessary information, appropriate feedback, uninterrupted communications and an atmosphere of trust and openness.

Cultural : This refers to the attitudes, values, beliefs, perceptions, and practices of individuals and groups within the organisation towards safety within the organisation. The cultural aspects can influence the value proposition, degree of commitment, fellow feelings, sense of priority, and a feeling of belongingness shown by the employees towards the Safety Management System. In brief from a People perspective a Safety Management System may be seen as a socio-technical system that relies on the performance of people (the 'operational' aspect) and the efficiency of the processes and procedures (the 'structural' aspect) in order to function successfully.

The case study

organisations will generally resort to all the three approaches of Regulation, System and People in varying degrees for managing safety in workplaces. The present case study has been designed to study their interrelationship and their impact on overall Safety performance of the organisations. Twelve large manufacturing companies from Bihar, Chhattisgarh, Jharkhand, Odisha and West Bengal were selected as participants for this case study. This represents a wide spectrum of Industries including Engineering, Construction, Steel, Beverage, and Chemicals. The study was conducted with 2015-16 data. A detailed list of action points was developed to assess the Safety management system and the safety performances of these companies. A written reply was sought from each of the participants against the action points. This was followed up by on site observations and interviews with selected people for in depth understanding of the issues.

A total of 91 action points were identified and put before the participant industries covering all the three aspects of safety management. The number of action points in different categories was distributed as follows.

Example one action point from each of the aforesaid three categories is given below for illustration purpose and to help in better understanding: Regulation: Whether Management has a system of periodic evaluation of the status of legal requirements and submission of returns to the legal authorities. System: Whether third-party safety audits are conducted at periodic intervals.

People: Whether workers participate in near miss &hazard reporting, safety suggestion scheme and involve in the proceedings of safety committee
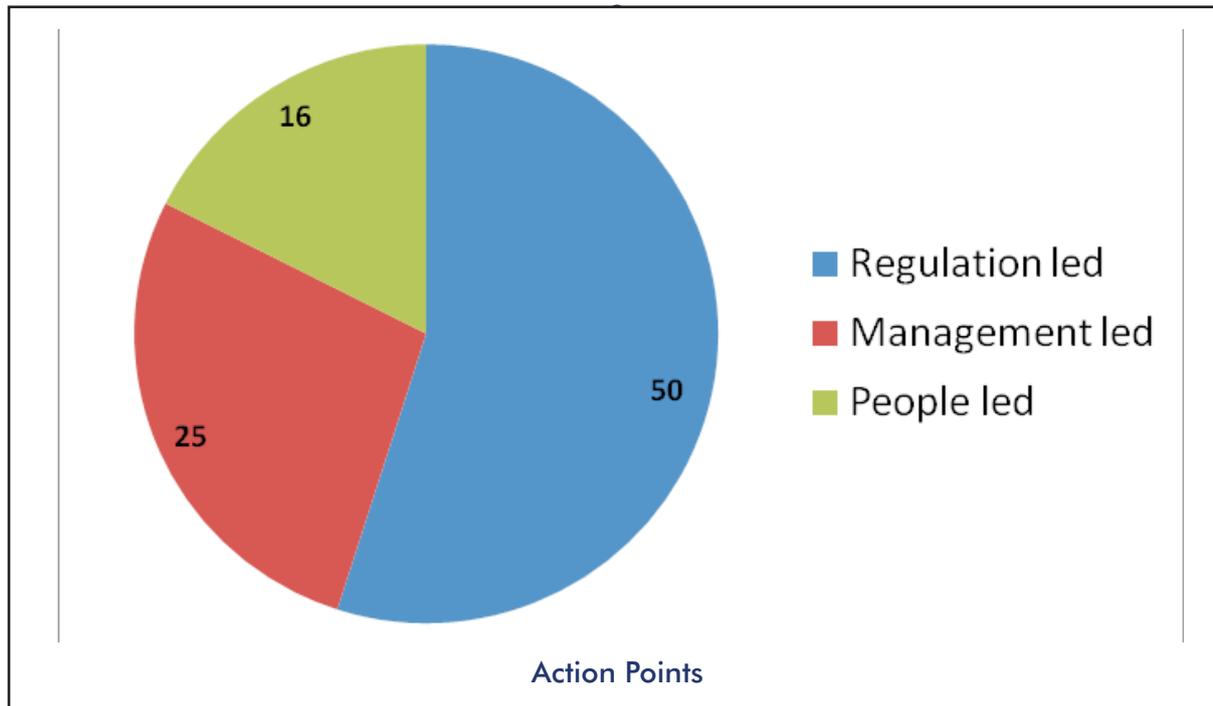
Action Points

Based on their performance status all 91 action points were evaluated on a scale of 0 to 10 by experienced assessors. The assessments were based on the written reply of participant organisations, the assessment done during the site visits as well as the interviews with relevant people in the organization. The scoring was based on the following theme:

- If for addressing an action point no system exists and only the chance factor decides the outcome the score given is Zero

- When there is a system available but this is only partially implemented score has been decided on the basis of the extent of implementation and coverage

- When a system exists and is fully implemented across the entire organization the score is obviously 10.

As indicated above, the idea of this case study is to explore the relationship between the status of actions taken in three areas as noted above and their impact on the safety performance of the organization. It was therefore necessary to select one common safety performance metric which is comparable across the organisations and at the same time can be easily assessed.

The parameter selected for this study was "Lost time injury frequency rate or LTIFR". A lost time injury (LTI) is an injury sustained by an employee that will ultimately lead to loss of productive work time in the form of worker absenteeism. LTIFR refers to lost time injury frequency rate which is computed as the number of lost time injuries occurring in a workplace per 1 Million man-hours worked. A LTIFR of 3 for example, shows that 3 lost time injuries occur on a job site for every million man-hours worked.

The LTIFR of each of the participating industries were compiled and collected for comparison.

The presentation and analysis of data :

The data concerning the assessment results of the 12 Manufacturing companies are illustrated. All scores from this assessment have been shown in percentage term for ease of comparison. LTIFR has the unit of number per million man-hours worked as explained already. For the purpose of confidentiality the names of the industries have been withheld. These are designated as M1 toM12. As explained above all are manufacturing type large industries functioning in the eastern Part of India.

| Industries	Score of Regulation related issues (%)	Score of System related issues (%)	Score of People related issues (%)	LTIFR
M1	78.4	74.7	80	2
M2	83.1	73.3	80	0.43
M3	95.4	92	97.7	0.17
M4	86.9	100	84.4	1.3
M5	83.1	72	48.4	4.3
M6	78.5	72	64.4	0.67
M7	74.6	61.3	44.4	6.3
M8	92.3	94.7	92.2	0.77
M9	59.2	57.3	51.1	11.3
M10	85.4	82.6	46.6	3.4
M11	85.4	65.3	84.4	0.54
M12	96.9	96	86.7	0.15
Average	**83.3**	**78.4**	**71.7**	**2.6**

Table - 1

Let us examine the data presented above in some detail. We examine the average scores of the three areas across all Industries in the following graph.
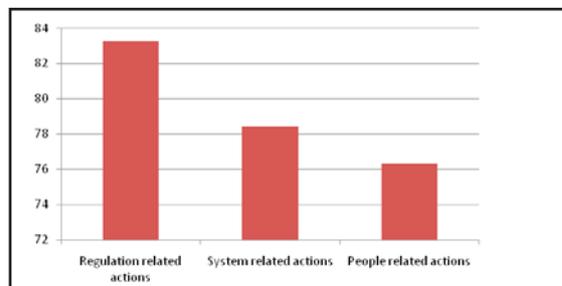
Average score %

The figure shows average score percentages across all industries with respect to the actions related to Regulation, System and People. As can be seen the average picture emerging is that the performance of Industries is lowest for the people related actions. The performance is highest for Regulation related actions followed by System related actions. People issues are relegated to the third spot. The reason for this may be the organisations still do not appreciate the importance that the people issues deserve. Another reason may be that actions related to people issues are complicated, tricky, painstaking and therefore, not easy to implement. There are no shortcuts. We shall return to this theme later. Let us now turn our attention to the impact these scores have on the overall safety performances of the participating industries.

Performance Chart

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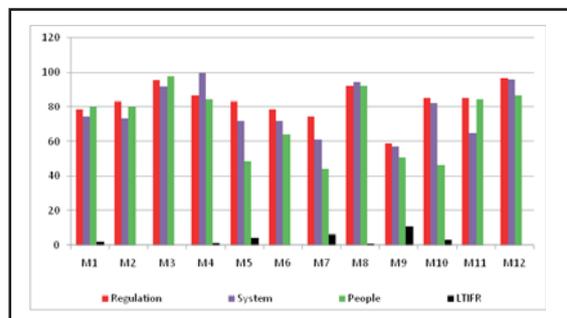
The red columns represent Regulation, Blue represents System and the Green represents People. The taller the columns, the better it is for organisations. The black columns are LTIFR or accident frequency rates and therefore, their beingshorter is better. For M3 and M4 performances with respect to all the three parameters are around 90%. This is clearly reflected in their Safety performance. There is almost Zero LTIFR.

M7 and M9 fall in a different class. For M9 all areas are below 60% and for M7 except one other two areas are just 60 or less. No wonder accident rates are high for both these industries. Interestingly even those industries which did much better with respect to regulation and system but fared poorly in People issues has suffered higher accident rates. For example, M5 and M10 where accident rates are higher in spite of better compliance. Only reason that explains the situation is their lower performance in People areas.

The scatter diagram drawn below brings out the matter with more clarity.

This is a scatter diagram showing the scores with respect to the three areas against the accident rate or LTIFR. It may be noted that the cluster at the left hand upper corner which has been circled and designated as "A" has the lowest accident frequency rates. Clearly their high score on people front has contributed to this. For the industries which fall in cluster B the People score is lower (Green points) and these industries quite predictably account for much higher rates of accidents. This establishes a clear relationship of the performance of People related action points and the accident rates. To succeed in achieving higher performance in safety one must therefore, turn his attention towards the people issues.

Interpretation of the data and discussion

In light of the foregoing arguments the following conclusions can be drawn:

- The efforts towards managing Safety in Industries are still largely directed toward compliance with regulatory and system requirements. People issue gets the least priority. This area has not been adequately explored and importance of People issue in safety management is not widely appreciated by the Industry.

- While regulation and systems related issues are still needed to be addressed for any meaningful framework for

LTIFR ⟶

Accident rate
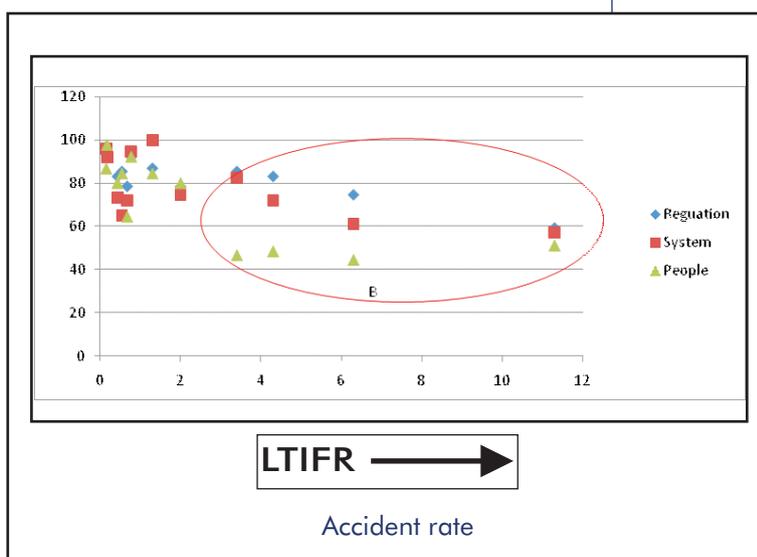
managing safety in workplaces, by themselves they cannot produce the desired results. Some industries in spite of having done well in compliance to regulatory and system requirements have still failed to achieve the desired results – mostly for ignoring the people issues in their respective organisations.

- Safety management have to be a 'living' system, rather than as a collection of rules, regulations, documents, and procedures. However, this viewpoint introduces special considerations for people as the only resource capable of thinking and acting in a meaningful way when adequately trained and motivated. It is no longer sufficient to focus on the production of technically correct policies and procedures. People must be brought back to occupy the central place. This can be achieved if attention is directed towards these three areas:

- Consideration of people as the only dynamic agent capable of interacting with the one another both individually and in groups, with systems and hardware. People can be trained, motivated and empowered to act as a thinking member in the organization willing to contribute toward Safety.

- Compliance to regulation and system requirements are best achieved when people behind are knowledgeable and motivated.

- Systematic integration of people with different safety functions of the organization into a coherent whole will result in a dynamic and responsive safety management in Industry.

Building a people oriented organisation

In the previous sections we have seen that "People" occupy the central position in any effective and successful safety management program. We have also seen that this area has not received the importance it deserves. Many organisations have tried to do something in their own way but as the data reveals these are neither adequate nor comprehensive enough to make substantial impact. The question therefore, is how to bring this change? What makes people behave in a more responsible and constructive way to build a safe workplace? What motivates them to act in a proactive manner? In this section we shall try to find the answers to these questions. Traditionally most of our safety related actions are programd along the lagging indicators. The accident statistics, injury reports etc that seems to drive our efforts to improve safety performance. We tend to overlook the leading indicators and therefore, fail to prevent incidents. We analyse accidents and then try to find the probable causes and take remedial actions, and issue new directives, new restrictions, and new procedures with the hope that the accident will not repeat in future. But the next accident happens in some other place in a totally different context. Reactive approach alone cannot produce the desired result. Realising this fact organisations have often resorted to new proactive way of managing safety. For a long time, training has been a handy tool for the safety professionals to imbibe safe practices. This has been quite useful also as it helped to educate the workmen to use safe practices in

accomplishment of a given task. However, not all training programs are equally relevant and effective and therefore, fail to enthuse the workers as a whole. Moreover, it is also too much to expect that workers will correctly follow all the lessons learnt in a training program in real life situations all the time unless other reinforcing factors are introduced. Therefore, Training is useful but not sufficient to bring the desired changes.

Behaviour Based Safety or BBS is another approach used to induce workmen to exhibit positive and safe behaviour in a given work related situation. It is thought that human behaviour contributes substantially to the unsafe acts at the workplace and can therefore, be the source for a large number of incidences. If we can ensure safe behaviour from the workmen we can achieve a substantial impact on safety at workplaces. That is how the thinking goes. Various approaches have been tried and had reasonable success in reducing unsafe behaviours in the workplace. Some involve reward and penalties; others involve surveillance; still others involve guidance, codes and procedures to follow.

Let us examine the philosophy of BBS in brief.

Behaviour is explained in terms of the ABC model (Antecedent, Behaviour, and Consequence) as shown below.

Behaviour can be shaped or modified through appropriate design of antecedents and also by structured and unbiased consequence management. The important antecedents for this purpose are training, work instructions, SOPs of company policy, legal and regulatory requirements etc. The consequences that are generally important in these cases are timely completion of job, reward, recognition, injury in work, reprimand, punishment, loss of personal reputation etc. As can be seen from the preceding examples, the consequences could be negative or positive. A negative consequence will have the effect of avoiding such behaviour in future and are also called negative reinforcement of behaviour.

Positive consequence will encourage the worker to repeat such behaviours in future and are therefore known as positive reinforcements. Traditionally organisations have relied more on antecedents. Examples are policies, rules, procedures and the administrative controls over employee behaviour. These are easy to administer.

Antecedent	Behaviour	Consequence
A stimulus or event that occurs before "behaviour" in time. This precedes the behaviour and is supposed to shape the behaviour. **Example: A standing instruction to all welders to use safety goggles during welding.**	Anything that we can see an individual do, or say. This is actually the way a worker goes about in accom- plishing his task. **Example: A welder carries out welding job without wearing goggles.**	A stimulus or event that occurs after "behaviour" in time. This is a consequence of displaying certain behaviour. **Example: The welder is warned by his supervisors for having failed to use goggles during welding**

Consequence management is more difficult to implement. But the experts feel, it is the consequences that have the greatest influence on behaviour. Therefore, our efforts should be directed more towards consequence management for encouraging safe behaviour. A BBS program will succeed if the following ingredients are present is sufficient measures.

1. Engagement from both employees and management.
2. Clear, concise definitions of behaviours targeted for change.
3. These targeted behaviours are chosen from past incident reports, safety assessments, observation, and near miss data.
4. An observation process.
5. A feedback process.
6. Target behaviours for employees, supervisors and managers to improve, including measurement and feedback.
7. A process for identifying and liquidating hazards.
8. A consequence management program for the targeted behaviours.

BBS is a good way to address the people issue in Workplace safety though it has one serious drawback. By emphasizing on the safe behaviour BBS puts too much burden on the workmen's behaviour for ensuring safe workplace. It ignores the fact that individual behaviour is to a greater extent influenced by the prevailing ambience in the Organization and the collective mindset. This leads us to the next higher form of people engagement through developing a Safe working culture. This is dealt with in the next section.

Developing a safe working culture

As we have seen in the previous section unsafe behaviour of workmen is not merely about the personal trait of the workmen. The psychological, emotional and situational aspects are equally responsible to shape the behaviour pattern. We cannot achieve a desired outcome on safety unless we address the issues at their entirety. We have to admit that the organizational ambience, its value system, expectations, group norms, perceptions and collective mindset have a profound impact on how a person behave in a given situation. These factors clearly differentiate between organisations with respect to the work culture. It is the culture of a place which compels a man or woman to behave in a particular manner. The same individual will behave differently if taken to a different culture. Think about a taxi driver working in Kolkata. We are all aware of their behaviour pattern in compliance to traffic rules. The same driver working in city like Singapore exhibits a totally different set of behaviour. The person has not changed but the culture has; and that has made all the difference. Much more than an individual trait, the safe behaviour is a function of the organizational ambience. Therefore, we need to direct our energy more towards developing a safe work culture in the organization rather than to modify the behaviour of individual workers. Safety Culture can be defined as the product of individual and group values, attitudes, perceptions, competencies and patterns of behaviour that can determine the commitment to, and the style and proficiency

of an organisation's health and safety management system. Safety Culture has three distinct aspects
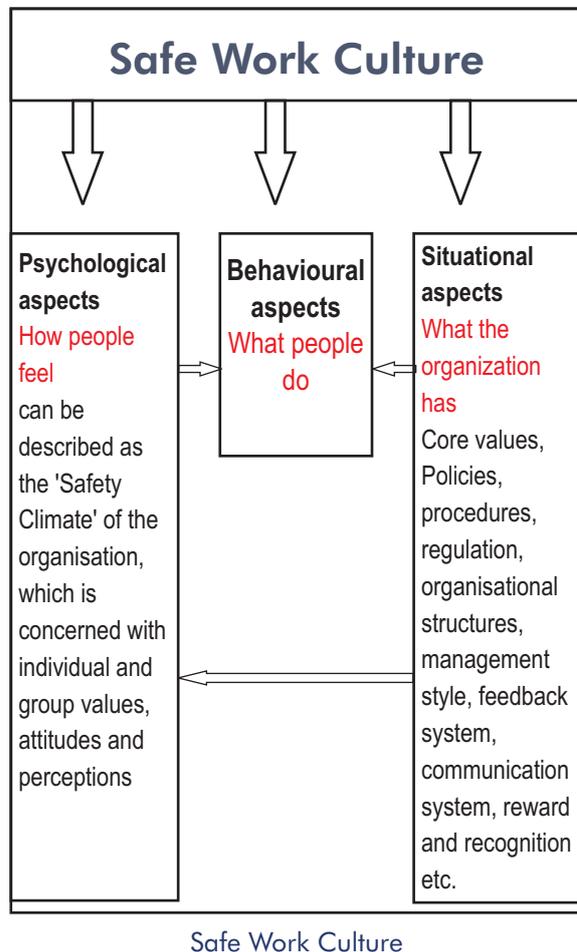
1. Psychological

2. Behavioural

3. Situational

Psychological aspects : Psychological aspect is how people in the organization feel. Do they feel empowered or helpless? Can they talk and communicate freely or there are insurmountable organizational barriers? In other words this describes the sSafety climate prevailing in the organization. These psychological factors have a very big impact on the behavioural aspects also. This aspect greatly affects individual and group values, attitudes and perceptions.

Behavioural aspects : This is about "what people do at the workplace and the way they do it". All activities and behaviours of people which are related to safety come under its purview. Both psychological and situational aspects have profound effects on "People's behav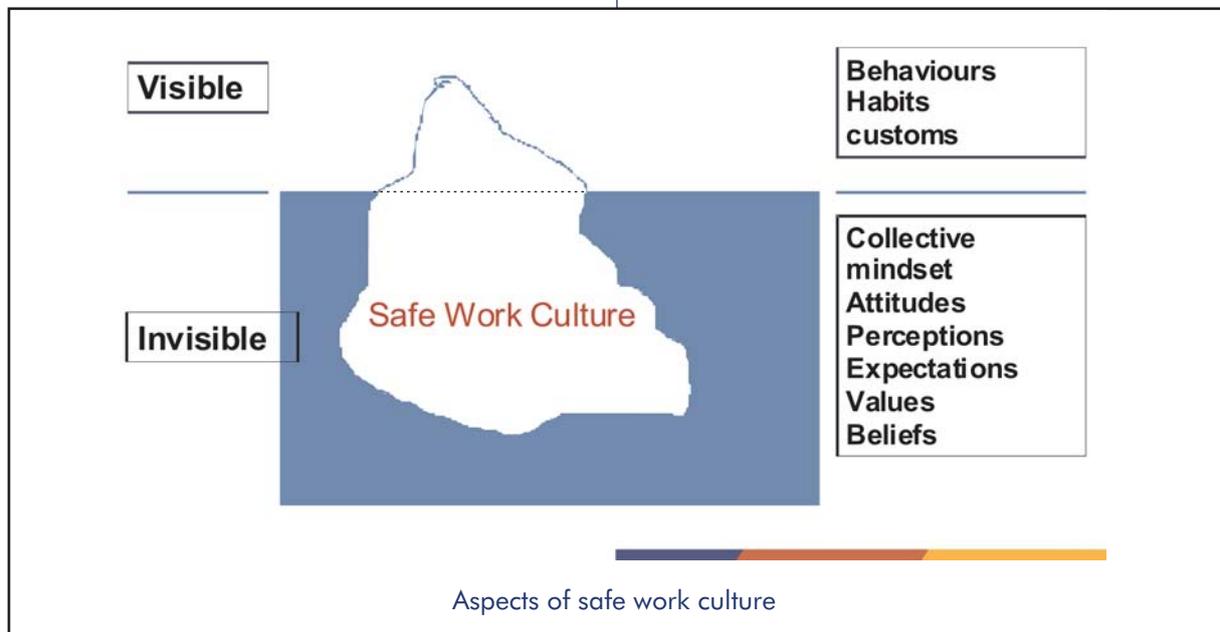iour" either positively or negatively. **Situational aspects** : This aspect is about "what the organization has". It's Core values, Policies, procedures, regulations, organisational structures, management style, feedback system, communication system, reward and recognition system and a host of other issues define the organizational ambience. The situational factors in turn have immense impact on both psychological as well as behavioural factors. The action to build a safety culture has to begin here. A systematic intervention program to alter and align the situational aspects is great way to develop a Safety Culture in the organization. The relationship between these aspects is

shown schematically below.

Safe Work Culture

Psychological aspects	Behavioural aspects	Situational aspects
How people feel	What people do	What the organization has
can be described as the 'Safety Climate' of the organisation, which is concerned with individual and group values, attitudes and perceptions		Core values, Policies, procedures, regulation, organisational structures, management style, feedback system, communication system, reward and recognition etc.

Safe Work Culture

Situational aspects have a role to shape the psychological as well as behavioural aspects of people and are therefore, the most important areas to focus. The challenge to build a safe Work Culture thus requires building favourable situational factors into the organization. Let us find out what the favourable situational factors are and how they can be built into an organization.

It is often said that safe work culture is like an iceberg where only an insignificant portion is visible at the surface but the major portion is

hidden below or invisible. This is explained in the figure below:

Aspects of safe work culture

The visible portion of the culture has such element like behaviour, habits and customs. Invisible factors like Values, collective mindsets, attitudes, perceptions, expectations and beliefs etc. are the causes. Visible employee behaviour is the effect. Employee behaviour is actually shaped by the invisible situational factors like values, perceptions, beliefs, expectations etc. Working on employee behaviour alone will not yield the desired results. The organisations have to plan and execute meticulously in these areas to build a safety culture.

To develop a safe work culture the organisations must act in the following areas.

o Presence of a supportive and committed leadership

o Consistent and unbiased adherence to the organizational core values

o Establishing a sound internal communication system including an employee feedback system on all safety related issues.

o High employee participation in safety related matters like safety events, training, risk assessment, accident investigation, suggestion scheme, hazard reporting, toolbox talks etc.

o Sufficient health and safety resources

o Focusing on anticipating and pre-empting problems rather than reacting to it by working on the leading indicators to manage safety (Job safety analysis; Hazard reporting, Safety observation, training, etc) rather than the lagging indicators (Accident statistics, audit reports etc.)

o Encouraging Low Level of Risk-Taking Behaviours

o Establishment of a sound and unbiased

reward and recognition system for safety related activities.

o Developing trust between management and frontline staff o Ensuring Good Contractor Safety Management

o Maintaining High Levels of Competency

A Safety Culture consists of shared beliefs, practices, and attitudes that exist in an organisation. The culture is the atmosphere created by those beliefs, attitudes etc., which shape our behaviour. When a worker finds him in a culture which supports safe behaviour his own behaviour will change and align with the organizational culture. The role of managers is to maintain the positive organizational ambience rather than trying to change individual employee behaviour.

However, there are certain barriers to building a safe work culture in any organization. It is important to recognise the barriers and take effective steps to counter these for achieving long term cultural change. Here are some examples:

1. Management styles may be different between departments. This may create inconsistencies in the right message being sent

2. There may be weaknesses in the communication interface. Unclear lines of communication may cause confusion and a lack of involvement in the process

3. Management's role in balancing the principles, policies, objectives, and Safety Culture among the functional areas is often constrained by an inability to communicate between the top and bottom of the organisation.

4. Safety is viewed as just a goal among many other goals and not a non-negotiable value proposition.

5. Production targets override safety

6. Tendency to compromise organizational values when it comes in the way of achieving short term targets.

The organization should have in built checks and balances to counter such barriers.

Finally it must be noted that only building a safe working culture can ensure long lasting safe and healthy workplace. It will drastically reduce health and safety related incidents and improve employees moral. Achieving legal compliance and system implementation is a prerequisite but not sufficient condition for building a safety culture. The culture has to grow organically from within the organization keeping people at the centre under the watchful eyes of a supportive leadership till it is fully matured and integrated with the organizational cult.

Technology driven safety

In the paper so far we have discussed the role of people in management of safety. We have also suggested a number of methods for enhancing the role of people and improving safe work culture. Another dimension of managing the manufacturing process for improvement of quality, efficiency and safety in industry is developing fast. A new spurt of technologies is going to rule all facets of manufacturing including quality, efficiency and safety. This is 'Smart Manufacturing or technology driven manufacturing. Under technology enabled manufacturing process, safety has a very important place. We may

call it 'Smart or Technology driven Safety'. In coming days it is going to revolutionize the concept of safety in Manufacturing Industry completely. This section of the report will deal with Smart or Technology driven safety.

The world's top manufacturing industries are now facing challenges from increasing labour and resource costs, shift of production paradigm moving from economies of scale to customization and increasing concerns for environment and safety. The leading experts in technology domain all over the world are focussing on design of sensors, capturing and compilation of a large volume of multilayer data, and analytics associated with it. This is accelerating vital upgrades of technology in manufacturing and helping optimization of Industries' structures and systems.

These improvements in technology have led to a high degree of connectivity between devices on the shop floor as well as handling of a much higher volume of collected data than ever before. Smart Analytics and Real-time Analytics have made it possible to optimize the manufacturing processes. The data can pinpoint to the combination of process parameters which will lead to better yields, better quality and better safety. The data can also reveal the manufacturing issues which have the highest impact on quality and safety so that managers can assess and mitigate the associated risks on a continual basis.

Traditional maintenance depends on expert knowledge and is usually procedure based. However, manual solution suffers from inaccuracy caused by human failure and difficulties in adapting to changes. Under smart manufacturing, industry can expect much better results when the enumerable

devices are connected and zeta-bytes of data are being generated. Predictive maintenance utilizes this huge mass of data with advanced machine learning capability to identify patterns and extract knowledge from data. Sensors and machine to machine communication have improved dramatically. These improvements enable a high degree of connectivity between devices on the s shopfloor as well as the capability to handle a much higher volume of data than ever before.

HSE Management

Accidents caused by sudden and hazardous material spills, in chemical industries can cause great bodily injury, property losses, and long-term environmental damage. Current practices in many industries still depend a lot on manual inspection and interventions with associated error and risk. Technology can offer remedy in these situations through automatic inspections of vital parameters and generating automatic alerts. This can drastically reduce the number of incidents on the shop floor. As technologies mature, data acquisition costs for sensors and communications will come down and further encourage the utilization of HSE-related solutions. A good example is our Oil refineries. The oil refineries carry hot and toxic fluid under pressure over long distances through a net work of pipelines. This involves a considerable risk of pipeline failures or joint failures causing fatal accidents as well as damaging of environment. A number of similar incidents have been witnessed in the past. Oil refineries are often constrained to manually measure the wall thickness of pipeline sections periodically which are inefficient, error-prone, and labour-intensive.

Sensor based technologies and solutions

The wide-scale introduction of technology can make routine automatic pipeline inspections easier because of improved measurement accuracies, workload reductions, prevention of safety risks. Similarly the timely detection of leakage of hazardous toxic gases is also critical to mitigating risks. With properly calibrated detection equipment in place, people can be alerted to the dangers in near-instantaneous time frames, thereby reducing the incidence of equipment failure and bodily harm. The point is to provide in-built system alerts into all hazardous activities so that the issue can be promptly resolved to prevent the escalation of small problems into large-scale environmental disasters.

Safety sensors based technologies and solutions play a pivotal role in ensuring safety of employees and workers in manufacturing, chemical, mines, power plants and construction sites. The safety sensors act as an on the spot source of critical information for the individuals operating the equipments and machines on the shop floor, mines with hazardous and toxic air quality, oil rigs with highly combustible oil and natural gas environment, power plants with high voltage grid and electronic magnetic radiations or the construction sites where probability of physical damage due to accidental errors are prevalent.

The industrial safety sensors for the shop floor include safety light curtains, laser scanners, and anti-collision sensors. Other sensors such as proximity, fibre optic, vision, infrared, laser, magnetic and ultrasonic sensors are commonly present in the industrial safety devices.

Sensors such as – Air Quality Sensors for identifying the Level of Poisonous Gases such as Carbon Monoxide in an underground mine or Humidity, Moisture, Fire and Smoke detection Sensors and Respective Prevention Systems, or VESDA (very early smoke detection systems) which are prevailing in the IT/DC/ Commercial Building environment are also equally important in Factories, Mines, Automotive plants, Power grids, Oil rigs and other industrial facilities and construction sites. These end equipments with the built in sensors can act for generating automatic and immediate alerts as well as for initiating auto correction in the system dynamics. It is also capable of sending sufficient data to the Plant Management for initiating corrective actions as an immediate or planned response as the situation demands. Typically the sensors send the data to the PLC/SCADA systems which are integrated with the plant processes thereby automate the processes to achieve desired level of safety and efficiency. Manufacturing industries use heavy machines (such as material handling, packaging, conveyer belts, assembly, machine tools, robot cells, palletizers, transport systems etc) and have the potential to cause severe workplace injuries to the employees such as crushed fingers or hands, amputations, burns or blindness. The same is equally applicable to employees working in High Voltage environments such as power plants, Power grids, or employees working at Oil rigs or underground mines, Hazardous Chemical plants or thermal/nuclear power plants. All such industries can benefit from a judicial selection and use of sensors.

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The manufacture and use of sensors is getting more and more structured due to increased standardization. The IEC/ISO jointly prepared the Guide 51 as a criterion for establishing standards concerning machinery safety. Europe set down Machinery Directive which deals with machinery and safety components; the regulatory bodies in North America region include Underwriters Laboratories Inc. (UL), American National Standards Institute (ANSI), Canadian Standards Association (CSA) and Occupational Safety and Health

Administration (OSHA); China Compulsory Certification (CCC) is a mandatory certification system pertaining product safety in China. Japanese products are checked under the Electrical Appliance and Material Safety Law.

A number of technology companies are already contributing to many such Industrial Safety initiatives and has integrated solutions deployed with the help of Mobility, Collaboration, Industrial Grade Routing, Switching, Wireless and Wired network platform and Data Virtualisation solutions.

Examples of Personnel Health and Safety

Examples of Personnel Health and Safety

Source : Cisco India Pvt. Ltd.

Vehicle traffic safety

Another area for application of technology is the control of vehicles. Vehicle Control Networks monitors and manage vehicle movement and the associated infrastructures. It can have a significant impact on vehicular traffic safety.   Many vehicles are now equipped with GPS systems that upload the vehicle position to data centres via a GPRS or 3G networks. In future, interactions between vehicles, roads, drivers, and sensor devices will become routine, and the sharing of such information, even information about ambient environments, will become commonplace.

Information collected from diverse sources, processed, computed, shared, and released using secured information platforms will provide advanced guidance and supervision for vehicles.

The technology for smart manufacturing is still emerging. In India the landscape is evolving. One thing is sure, the idea of smart manufacturing is here to stay and this has already started making significant impacts on our management strategy and investment planning. Sooner we are able to appreciate and internalize the technology better it is for the Indian Industry and also for Indian economy.

About Consultivo

Consultivo is a management advisory and consulting firm helping global businesses in the areas of Sustainability, Business Excellence & Risk Management both in strategic and operational level.

With access to a wealth of intellectual capital, Consultivo delivers Advisory, Research & Training services in the areas like Occupational Health & Safety, Environment Protection, Corporate Social Responsibility, Sustainability, Management Systems, Organizational Development, Food Safety, Inspection and Human Capital Development.

Under the vertical Environment, Health & Safety (EHS), Consultivo provides assessment, consulting and training services in areas like General Safety, Electrical Safety, Chemical Safety, Construction Safety, Fire Risk Assessment, Logistics Safety, Contractor Safety, Ergonomics Survey, Process Hazard Analysis, Behaviour Based Safety, Emergency Preparedness & Emergency, OHSAS 18001, Workplace Stress Management, Accident Investigation, EHS Legal Compliance, EHS Due Diligence, ISO 14001 and related services.

Consultivo work with 70+ National and International Sustainability related standards. Few of the standards we work with are Indian Standards, Indian Legal Requirements related to Occupational Health & Safety, Oil Industry Safety Directorate (OISD) Guidelines, International Good Practices, OHSAS 18001, Indian Standards on Safety, OSHA, Country specific legal requirements.

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About CII

The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering industry, Government, and civil society, through advisory and consultative processes.

CII is a non-government, not-for-profit, industry-led and industry-managed organization, playing a proactive role in India's development process. Founded in 1895, India's premier business association has over 8000 members, from the private as well as public sectors, including SMEs and MNCs, and an indirect membership of over 200,000 enterprises from around 240 national and regional sectoral industry bodies.

CII charts change by working closely with Government on policy issues, interfacing with thought leaders, and enhancing efficiency, competitiveness and business opportunities for industry through a range of specialized services and strategic global linkages. It also provides a platform for consensus-building and networking on key issues.

Extending its agenda beyond business, CII assists industry to identify and execute corporate citizenship programmes. Partnerships with civil society organizations carry forward corporate initiatives for integrated and inclusive development across diverse domains including affirmative action, healthcare, education, livelihood, diversity management, skill development, empowerment of women, and water, to name a few.

The CII theme for 2016-17, Building National Competitiveness, emphasizes Industry's role in partnering Government to accelerate competitiveness across sectors, with sustained global competitiveness as the goal. The focus is on six key enablers: Human Development; Corporate Integrity and Good Citizenship; Ease of Doing Business; Innovation and Technical Capability; Sustainability; and Integration with the World.

With 66 offices, including 9 Centres of Excellence, in India, and 9 overseas offices in Australia, Bahrain, China, Egypt, France, Germany, Singapore, UK, and USA, as well as institutional partnerships with 320 counterpart organizations in 106 countries, CII serves as a reference point for Indian industry and the international business community.

CII

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