

Transforming to a Multinational Cultural Organization: Strategical Change in the Safety and Environmental Aspects and its Regulation in Hazardous Chemicals Handling Industry

Yudhistrakumar Alavandar^{1*}

¹NovoPor Advanced Science Private Limited, India

*Correspondence to: yudhistrakumar@gmail.com

Abstract:

The strategic cultural shift implemented by the multinational company (MNC) has significantly advanced the organization's Environmental Health and Safety (EHS) objectives compared to previous management practices. These cultural changes have fostered a stronger safety culture and enhanced environmental protection. By employing both qualitative and quantitative data collection methods, the study highlights key strategic initiatives that contributed to these improvements. Notable advancements include the introduction of an online safety training platform, which increased occupant safety awareness, and the implementation of an online work permit system for better activity tracking. The adoption of a three-dimensional safety approach has strengthened process safety management, while environmental monitoring has improved through online pollutant tracking and biweekly leak detection tests to reduce fugitive emissions. Overall, the transformation in organizational culture under MNC leadership has elevated safety and environmental consciousness across the workforce.

Keywords: MNC; EHS; online safety training; online work permit system; increased safety

INTRODUCTION

Chemical, pharmaceutical, fertilizer, and polymer industries use hazardous chemicals, which are used for the manufacturing of finished goods (Agarwal et al., 2018; Sun et al., 2020), which are distributed globally based on market demand (Slunge & Alpizar, 2019). Many global companies have acquired Indian companies in recent times (Bhattacharya, 2018; Poddar, 2019), as India is one of the fastest-growing economies in the world (Bala, 2020; Sankaran et al., 2020). Due to the acquisition of global companies, India is becoming the safer hub for the manufacturing of hazardous chemicals, which has resulted in the transformation of the vision to improving the environmental aspects and safer handling of hazardous chemicals that are used during the manufacturing process (Bhusnure et al., 2018). Improving the environmental aspects, which helps in preventing global warming and reducing the greenhouse gases in the environment, thus adhering to the environmental, social governance (ESG) in India (Chelawat, H., & Trivedi, 2016; Sharma et al., 2020; Rao et al., 2023). Strict safety controls have been followed to adhere to the environmental, health, and safety (EHS) policy of the organization after its acquisition by the multinational company. The safe controls, which include men, material, and machinery protection, is known as the 3M safety concept, which is a new visionary approach for the safety aspects. Men emphasize administrative controls and materials and the safe handling of toxic, flammable, oxidizer, irritant, and corrosive chemicals (Liu et al., 2017; Hill, 2020; Rao et al., 2020). These chemicals, which are used in the process equipment to get the desired product, refer to the process control concerning the temperature, pressure, and addition of chemicals in the process as per the standard operating procedure (SOP) (Qian et al., 2023). The main objective of this paper is to emphasize the changes that have resulted in the organization's cultural changes in the environmental and safety aspects after the acquisition of the multinational company. The information that we have shared will help the various hazardous manufacturing industries across the globe to know the cultural changes that will help us improve the safety aspects and protect the environment so that future generations can lead a safer and healthier lifestyle. The paradigm shift significantly affects the risk management approach for handling the process equipment (Villa et al., 2016), which has helped transform the organization's safety culture.

The three different factors have shaped the goals of environmental and safety aspects.

Three different factors are responsible for building good environmental and safety governance for the organization. The various factors include organizational, individual, and legal and statutory bodies (Figure. 1). The organizational factors are directly related to the EHS policy (Robson et al., 2016), whereas the individual factors, which relate to the individual contribution to enhancing the safety knowledge (Lee et al., 2016; Mearns, 2017; Ezenwa et al., 2022), further its handling of the critical reactions during the process and adhering to the policies, which are laid by the EHS department (Khair et al., 2018), during the MNC culture. Further, the legal aspects have resulted in compliance with the consent of the operations, which are laid out by the pollution control board authorities and other statutory bodies (Brooks & Streng, 2019). In any other case, as per figure. 1 where we see a fall-down approach, which has resulted in a moderate or low safety culture, it all depends on the factors the organization chooses to shape the safety and environmental aspects based on its EHS vision and its implementation (Figure. 1).

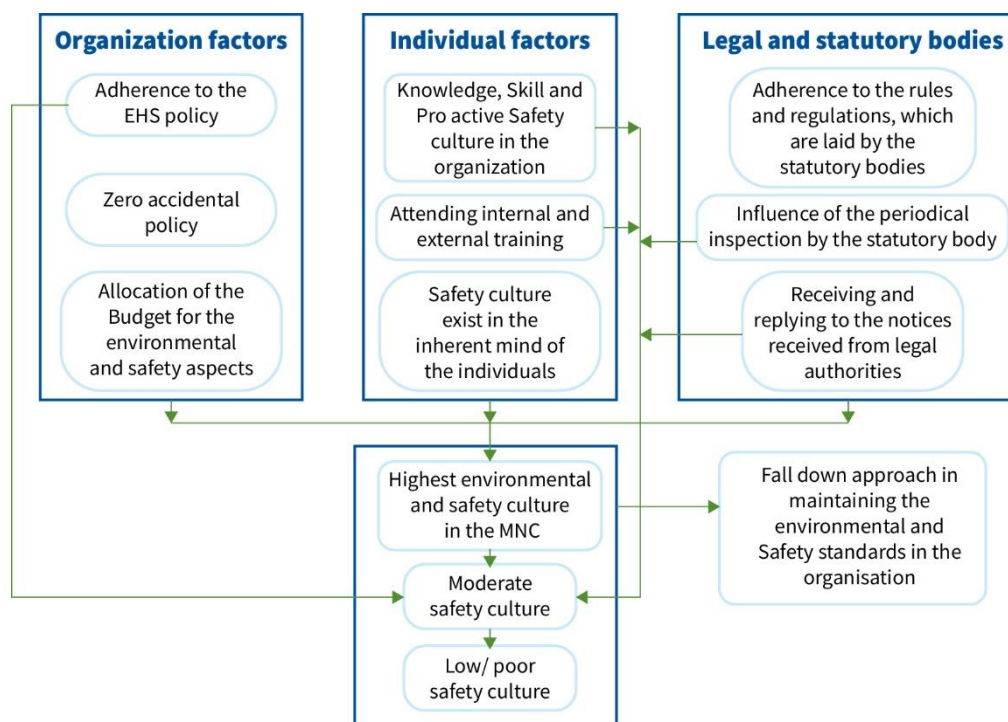


Figure. 1. Various factors which lead to the MNC culture / moderate safety culture / poor safety culture

The three-dimensional approach concerning safety aspects was introduced during the MNC culture. Strategical changes, which are brought in the form of the implementation of fourteen elements of process safety management (PSM), have been presented. Nwankwo et al. (2020) reported that PSM techniques, which are used globally to bring strategic changes, result in good safety culture in handling chemicals and processes in hazardous manufacturing industries. Overall changes made during the MNC culture compared to the previous management have been presented.

METHODS

There are 1100 workers who work in different blocks, and the MNC culture brings about their inherent changes. An overview of the previous management and its paradigm shift towards the building of the multinational, national safety culture in the organization concerning the safety and environmental aspects has been presented, which consists of dealing with environmental monitoring, safety-critical equipment, factors of responsibility, the difference in the culture of the earlier management and the MNC management of the change towards the improvement in the environmental and the safety aspects have been presented. A qualitative and quantitative methodology has been used to ascertain the present MNC strategy. The three-dimensional safety approach was introduced during the MNC culture, which has helped implement PSM, and its advantages have been presented. The introduction of the online platform for safety training and its benefits have been explained. Details of the online work permit system (WPS) have been briefed in this article. The risk assessment benefits concerning the process hazard analysis (PHA) for the consented products have been discussed.

RESULTS AND DISCUSSION

There are 100 reactors in the form of 40 glass-lined reactors (GLR), and 60 SS reactors are used for processing the molecules as per the batch management record (BMR). Further, it is processed in the agitated nutsche filter dryer (ANFD) to get the desired product in the hazardous chemical handling industry. These process equipment had a written document in the form of an emergency shutdown procedure (ESP) during previous management. Still, the employees were unaware of how to handle the operational equipment's emergency shutdown (Table. 1). Under the present multinational cultural organization, the shift in-charges and senior executives are trained to handle the emergency shutdown operations of the process equipment. In the few cases during the previous management, the people were trained to respond to Grignard's reaction to the shutdown operations. In emergency shutdown activity, the procedures are finalized only after performing a risk assessment during the present multinational cultural organization, as different reactions require different temperatures to be maintained during the shutdown of the process equipment. Pearson & Martinez (2023) stressed the importance of isolating the pressure vessels and the hazardous fuels. Many safety systems, such as the earth rite system (ERS) for unloading dangerous chemicals from the road tankers to the tank farm area, have increased from 6 to 14 no's during the MNC culture (Table 1). The continuous earth monitoring system (CEMS) for reactors and ANFD double earthing already existed during the previous management but earth continuity resistance testing towards the process equipment and its earth pit has been performed only during the MNC culture (Table. 1). The digital intelligent monitoring systems concepts and tools like CEMS plays vital to dissipate the static energy to the ground earth pit (Koedel et al.,

2022), which helps in avoiding the static energy of the process equipment. The sodium methiodide (SMO) chemical powder system was manually charged during previous management. Still, we have introduced a closed-loop powder transforming system (PTS) to avoid hazardous dust accumulation in the occupational environment during the MNC culture (Table. 1). Cheremisinoff (2014); Rantanen & Khinast (2015) have reported that dust inhalation by the occupants and dust explosions can be avoided by using PTS system in the pharmaceutical industry in Denmark.

Table. 1. Shows the critical equipment, which is used in the chemical industry, the responsible department, various factors responsible, and changes during the earlier management and the present MNC culture

Critical Equipment's	Responsible department	Factors responsibility	Earlier management	MNC Management
Emergency shut off system. [for example: Chlorination]	Production	Organizational and Legal requirement	System in place	Practical implication and operators are trained
ERS for road tanker unloading	Electrical	Organizational and Legal requirement	Only few were there	All the unloading road tackers are connected with the ERS
Emergency shut off system for Grignard Reaction	Production	Organizational, individual and Legal requirement	System was in place	
Monitoring of the CEMS	Electrical	Organizational and Legal requirement	No monitoring of the system	Monthly minoring of the system
Powder handling system for SMO & all other PTS Systems	Instrumentation	Organizational and Individual factor	Manul charging	Auto charging under nitrogen pressure
Chlorine & other process Scrubber	Production	Legal requirement	Manual monitoring	Online monitoring
Safety Relief Valve (SRV)	Mechanical	Organizational and Legal requirement	System was in place	Authenticity of release is checked every three months once
Thermal Relief Valves	Mechanical	Organizational and Legal requirement		
Rupture Disks (RD)	Mechanical	Organizational and Legal requirement	RD existed	Design changes has been made
Tantalum Plugs for glass lined reactor (GLR)	Mechanical	Organizational and Legal requirement	Found in few GLR	Introduced tantalum in all GLR
Temp. Readers/ Gauges	Instrumentation	Organizational and Legal requirement	OFF line monitoring	Online monitoring
Pressure Gauges/ Transmitters	Instrumentation	Organizational and Legal requirement		
Flow Meters	Instrumentation	Organizational and Legal requirement	Rotameter available	Monitored in SCADA
Bonding & Grounding (BG)	Mechanical & Electrical	Organizational and Legal requirement	System in place	BG is checked two months once

Critical Equipment's	Responsible department	Factors responsibility	Earlier management	MNC Management
Safety Interlocks & Trips	Instrumentation	Organizational and Legal requirement	Manual system	Every interlock opening and closing is done with SCDA
Nitrogen Plant & Nitrogen Blanketing Systems	Mechanical & Production	Organizational and Legal requirement	Few equipment's	All equipment's
Flame arrestors (FA)	Mechanical	Organizational and Legal requirement	No MESG study done	MESG study conducted and introduced FA
Spark Arrestors	Mechanical	Organizational and Legal requirement	Available	
Fire Pumps & Fire protection Systems	Safety	Organizational and Legal requirement	No proper monitoring	Daily monitored using check list
Power Back up from DG sets [DG Sets]	Electrical	Organizational and Legal requirement	Few DG Set	All DG sets
LEL & Gas Leak Detectors	Production	Organizational and Legal requirements	Few critical area	All the critical areas
Chlorine Leakage Kit	Production	Organizational and Legal requirement	Chlorine leak kit available	
SCBA's	Safety	Individual requirement	One in each block	Three in each block
Centrifuge Lid, ANFD Door interlocks	Mechanical & Instrumentation	Organizational requirement	Manual interlocks	Auto interlocks
EMS Monitoring Stations	Environment department	Legal requirement	Manual	Online monitoring
Emergency Lighting Systems	Electrical	Organizational requirement	Few locations	All blocks
Exposure Management Antidotes	Safety	Individual and Organizational requirement	Few available in OHC	Many were introduced in OHC
Ambulance	HR	Individual and Legal requirement	Available	
Fire Siren/Signalling System	Electrical	Organizational and Legal requirement	Available	
Spill control kit	Production	Organizational and Legal requirement	Few blocks	All blocks
Eye wash shower	Production	Individual and Organizational requirement	Few places	One in each block
Breather valves	Tank farm storage area	Organizational and Legal requirement	Few tank	Installed in all storage tanks

The scrubbing activity was carried out using 3500 to 7500 CFM scrubbing systems, which were carried out manually during previous management, but during the present MNC culture scrubbing systems were connected online, and the CS LYE charging and addition of the water in the scrubbing system for maintaining the pH of 12 to 14 has been automatically maintained by connecting through supervisory control and data acquisition (SCADA) (Table. 1). In consistence to the present scenario Promsawat

et al. (2016) reported that real-time online automation scrubbing system will help us to remove toxic fumes, which generated in reaction during the chemical process equipment such as reactors and centrifuges.

The Safety Relief Valve (SRV), thermal relief system, and rupture disk (RD) existed during previous management. Still, calibration of the safety relief system as per factory ACT 1948 has been carried out with the help of a competent person every three months once during the MNC culture (Table. 1). Florit et al. (2022) reported that the safety relief system devices are essential safety devices, which are used in the reactor equipment, in case of any pressure build up in the reactor, it will be released into the dump tank to avoid explosion in Italy. Many of the temperature, pressure, and flow transmitters were connected to SCADA during the MNC culture, avoiding manual intervention (Table. 1). All these transmitters are connected in the form of interlocks, thus ensuring the highest safety standards during the operation of the equipment's (Table. 1). Operating the process equipment's with safety interlocks by using SCADA helps to maintain highest safety during operations in India (Viswanathan, 2011). Nitrogen blanketing has been made compulsory for all the process equipment during the MNC culture, thus avoiding the oxygen content in the process equipment (Table. 1). Yanisko et al. (2011) have reported that nitrogen blanketing for the process equipment and storage tanks will help us in avoiding the explosion in the chemical industry, so it is also known as security blanketing. The vapor phases, which are generated during the reaction synthesis of the process equipment, result in the highest protection of the process equipment by using nitrogen blanketing, thus avoiding the pressure build-up (Bavarian et al., 2015), which has resulted in the safe operating culture in the chemical organization.

Flame arrestors (FR) existed for all the equipment used by the previous management. Still, to increase the proper effectiveness for avoiding the risk during the handling of the operational equipment, we have assessed the risk by using maximum experimental safe gap (MESP) and changed the FR for the process equipment (Table. 1). The MESP studies helps us for identifying the detonation effect of the flame effect, which may occur during the process can help us in avoiding the propagation of flame (Bao et al., 2021). Thus, we have followed the highest risk management approach during operations in the MNC culture. In the case of spark arrestors, it was introduced to all the incoming vehicles inside the factory during the previous management (Table. 1). Similarly, it was followed during the MNC culture.

We are having two firefighting pump houses with underground sumps with a capacity of 800 and 1450 KL, where we have Jockey, hydrant and diesel pumps existed during the previous management but daily wise checking for the operation of these pumps for tackling the emergency situation like fire in the occupational environment has been performed daily by introducing new check list, seen that the two fire pump house automation systems are functioning correctly, header hydrant line and wet risers in the occupational environment, which maintains a line pressure of 7 kg/cm² during the MNC culture (Table. 1). Atalaya et al. (2019) have reported the pressure in the hydrant lines are controlled using the program logic circuit in south America, where as in our case we have used sensors in the form of high pressure switch (HPS) and low pressure switch (LPS) to perform the automation when the pressure in the hydrant line decrease during the emergency situation, so that the pumps can be automatically switched on to tackle the emergency situation like fire in the chemical industry and after firefighting, the hydrant line will be normalized by maintaining the absolute standard pressure of 7 kg/cm². HPS/LPS is usually triggered in close/open mode by a 0.5 to 100 amps PLA relay. Power backup for all the DG sets was introduced during the MNC culture (Table. 1). The chlorine gas leakage detection kit was available during previous management, and the same has been used in the present MNC culture. In the case of the self-contained breathing apparatus (SCABA), there were only a single set was available previously in each block; now it has been increased to three numbers for each block during the MNC culture so that in case of any of the eventuality, three rescue operational workers can wear the SCBA for tackling the emergency in each of the blocks (Table.1). In case of a fire in the chemical industrial block, the trained emergency rescue team (ERT) member wear the SCBA to protect against the carbon monoxide (CO), polycyclic aromatic hydrocarbons (PAH), volatile organic compounds (VOC), benzene, hydrogen cyanide (HCN), benzo[a]pyrene, hydrogen fluoride and per- and polyfluoroalkyl substance (PFAS) are generated during the combustion process (Kim & Ham, 2023; Yang, 2023)

During the previous management, all the centrifuges and ANFD had manual interlocks. Now, all the interlocks were automated using magnetic sensors after the MNC had taken over the company, thus following the process of safety management (PSM) process laid out by the Occupational Safety Health Administration (OSHA) Part number 1910.119. Khan et al. (2021) reported that many of the hazardous chemical industries in the United Kingdom use magnetic sensors to increase the safety of operational equipment. In the previous management, the environment monitoring system was followed manually by recording the readings in case of presence of volatile organic compounds (VOC), chlorine (Cl₂) gas detectors, hydrogen (H₂) gas detectors, sulfur dioxide (SO₂), nitrogen dioxide (NO₂), PM₁₀, PM_{2.5} and suspended particulate matter (SPM) were monitored (Table. 1) but in the present MNC culture, every environmental monitoring device in the occupational environment is connected through real-time online software, which has a special facility to generate alerts in case any of the environmental monitoring parameters exceeds the pollution control boards (PCB) standards. These alerts are sent to the respective ecological department head through official e-mail. Further, these alert messages are sent to the official mobile numbers of the environmental and plant head so that we can immediately track the location and assess the situation of that region where there is an exceeding of the environmental monitoring parameter and avoid such type of exceedance of the value for environmental parameters, which are laid by the PCB authorities. Globally, NO₂, SO₂, and PM contribute almost 20, 10, and 8 % of air pollution (Teuchies et al., 2020), which impacts aquatic life. Ramaswamy et al. (2022), Chin et al. (2023), Wang et al. (2023) have informed that the environmental air pollution and its toxicity can be reduced by 100 % by using the effective wet scrubbing system in India and China. We have used a damp scrubbing system to neutralize toxic gases in our industry and remove the poisonous gases during the reaction in the reactor. In a few cases, there are chances that the liberation of VOC due to condenser vents because of less chilling into condenser tubes, further open boiling of the reactor manhole by some operators unknowing and improper tightening of the manhole of the process equipment, where we have received exceedance in PCB limits in the past during the previous management but now such of fugitive emissions were avoided and followed good manufacturing practices and engineering controls, which we controlled by SCADA has resulted

controlling all the environmental emissions in the multinational organization culture. Further, we have followed the leak detection test for any of the leakages during the process every fourth night to ensure that no abnormal pollutants are released due to not following the mechanical integrity.

Emergency lighting system for the blocks has been increased from 60 to 110 numbers during the MNC culture, thus ensuring proper lighting during the failure of electrical current, which is received from state electrical grid (Table. 1). Few antidotes were available in the previous management culture but in case of the MNC culture, we have introduced new antidotes such as Dimercaprol, Digi-Fab, further for treating the poisoning by using lipid-soluble drugs such as bupivacaine, propranolol, and verapamil (Table.1), which are maintained in the occupational health center (OHC) for treating the emergency situation with other prescribed drugs, which are recommended by the factory medical officer (FMO). The doctor in the form of an FMO is available 24/7 to treat the occupants in the occupational environment during the MNC culture. In contrast, in the previous management, the OHC doctor used to come in on the general shift only. The OHC ambulance was kept ready inside the company premises, where the driver was available to the company premises 24 X 7 during the previous management and MNC culture (Table. 1). There was an improvement in the health aspects of the workers after the introduction of the doctors for 24 X 7 in the occupational environment. They are also trained in health consciousness and well-being in the occupational environment, which has increased productivity in Italy (Assennato & Navarro, 2019).

The spill control kit in each block had two numbers in the previous management; in the present management culture, it has increased to 6 numbers in each of the blocks (Table. 1) in case of spillage of any of the hazardous chemicals for more than three liters, it has been considered as an unsafe condition in the occupational environment, so highest care has been taken during handling of the hazardous chemicals during the MNC culture compared to the previous management culture. Lee et al. (2016) reported that spill control management has helped normalize the occupational environment to improve safety aspects and learn lessons from the past in South Korea, which has improved safety precautionary aspects in the organization. In the previous management, we had only a few body and eye wash showers, which were located between the blocks; now, in the present MNC scenario, all the blocks have provided dedicated body and eye showers in each of the locations, which are connected to demineralized water (Table.1). Recently Powel (2023) has stressed the importance usage of the eye wash showers in the laboratories, where any of the showers and eye washes were critical emergency handling equipment, which is used in the critical environment, which is also considered a primary treatment in the various industries in United States of America (USA). Breather valves were installed in a few hazardous chemical storage tanks. In contrast, the breather valves have been installed in all the dangerous above-ground chemical storage tanks, which helps to maintain the equilibrium pressure inside the hazardous storage tanks and the atmospheric pressure that exists outside the hazardous storage tank, thus avoiding the shrinking of the chemical storage tanks and pressurizing the above ground hazardous chemical storage tanks in the tank farm storage area.

Concerning Figure 1, the three factors, which are in the form of organizational, individual, legal, and statutory requirement application to the various critical equipment and its devices, which are given in Table 1, which consists of the responsible department and its shows changes in MNC management culture compared to the earlier management concerning the safety and environmental aspects.

The three-dimensional safety approach has resulted in new strategic changes in the multinational culture.

The three-dimensional safety approach consists of good safety practices (GSP), safety precautions, and frequent checking of the process equipment and its devices (Figure 1)



Figure 2. A multinational culture has implemented a three-dimensional safety approach.

It has become mandatory to carry out the risk assessment for the WPS, and the risk assessment for the critical activity will be displayed in the work activity area. The occupants indulging in the activity can know the risk and take the required precautions while carrying out the activity. All the WPS are made online system; the main advantage is that we can generate a report considering the following points –

1. How many different permits have been issued per day, and are all the licenses closed in time, or has any permit extension been taken?
2. The user and executor will do digital signing-off, and the EHS clearance will be given.
3. Any deviation of the WPS, which is not closed in time and auto mail, is generated by the system and circulated as a reminder to the user, executor, and EHS clearance. A copy of the auto e-mail is sent to the chief operating officer (COO).
4. The equipment/device tracker is vital in knowing how often the same kind of WPS has been taken for that equipment/device.

Execution of activity in an occupational environment with a proper WPS can avoid incidents/accidents, resulting in a good risk management approach in Malaysia, which has been identified by a survey (Jusoh et al., 2020). We have practiced the GSP by implementing the WPS online and taking all the safety precautions by performing a risk assessment. Oldenkamp et al. (2024) reported that proper risk assessment with WPS will lead to a sound regulatory framework in European countries like the Netherlands. The digital copy can be shown to the factory inspector during the inspection. Thus, avoiding using paper for the WPS has saved precious environmental resources. Overall, the digital WPS platform saves time, as taking the signature from each department has been avoided, and work activity status can be tracked through the online platform. Further, we have introduced a digital training platform for workers in the occupational environment, which has ensured 100 % attendance for all employees and contractors for the safety training as per the schedule. If the safety training has not been attended as per the schedule, a request mail is sent to the head of the department (HOD). Suppose the worker fails to participate in the safety training. In that case, the swiping of the individual who has failed to attend the safety training will be stopped automatically at the factory entrance. So, in this way, we have ensured all our occupants, which includes contractors, employees, and visitors, are trained through the digital platform in the various safety aspects. The digital platform safety training has resulted in avoiding classroom safety training, which has resulted in saving man hours in the occupational environment, thus resulting in the GSP. Trifu et al. (2024) reported the advantages and disadvantages of the online training system in the occupational environment. The main benefit is that the safety trainer is not required to train the occupants in the occupational environment, and the other disadvantage is that any of the necessary clarification regarding the training aspects cannot be resolved through an online platform. In this regard, we have introduced a digital clarification mode in the online platform. The safety trainee can post their doubts digitally on the platform; the doubts will be automatically e-mailed to the safety department. The safety departmental executive will call the employee/contractor who has raised the query digitally and clarify the doubts so that all the doubts will be clarified directly; in this way, it has been ensured that all the occupants are well trained in the working environment.

We have introduced a risk management approach for all our manufactured products, which are in the form of PHA, a Hazard and Operability (HAZOP) study carried out for the consented products. It was ensured that all the queries raised during HAZOP were completed before starting the batch as per the BMR. This way, we took the highest safety precautions before manufacturing the product. The main advantage of using HAZOP is the risk mitigation approach, which leads to sustainable production for the chemical industries in South Korea (Nguyen et al., 2022). Crawley & Tyler (2015) have reported that conducting HAZOP for the products manufactured in the chemical company is the best practice of the PHA. Thus, they are used globally to mitigate the risk while handling hazardous chemicals and process equipment used for manufacturing in the chemical industry. The PSM fourteen elements of the Occupational safety health administration (OSHA) Part number 1910.119 has been followed in many organizations in China (Wang et al., 2023). The PSM elements were six (Employee involvement, operation procedure, training, contractor safety, incident investigation, and compliance), four (process safety information (PSI), process hazard analysis (PHA), hot work permit and emergency planning and its response) and three (prestart up safety review (PSSR), mechanical integrity and material of construction (MOC)) elements are GSP, safety precautions and frequent checking of process equipment and its devices. One of the final elements is the trade secret, which is the combination of the three-dimensional safety approach. We can say that the combination of the three-dimensional approach has helped us in the implementation of the PSM (Figure. 3). In the MNC culture, we followed a progressive culture for the improving of the safety and environmental aspects, where there the improvement in the occupational environment is an ongoing process, we intend to set the globalized standard to meet the EHS goals of the organization.

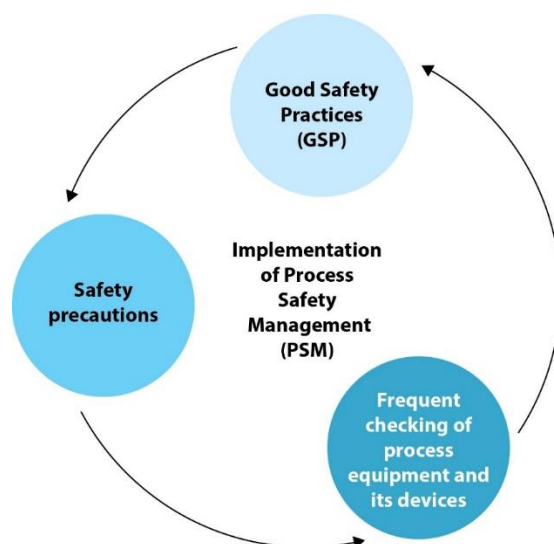


Figure. 3. The new three-dimensional approach has resulted in the successful implementation of the PSM.

CONCLUSION

There has been a strategic increase in safety and environmental standards compared to previous management. We have introduced a three-dimensional safety approach during the MNC culture in the form of GSP, safety precautions, and frequent checking of the process equipment and its devices, which was not there in the previous management culture. Online WPS systems

have helped track the status of the work activity; the main advantage is whether a similar WPS has been taken earlier for the same activity concerning that equipment/device or not. Increased safety awareness by implementing safety training through an online platform has resulted in compulsory for occupants working in the working environment. The three-dimensional safety approach has resulted in the successful implementation of the PSM. Overall, the strategic change brought during the MNC culture has resulted in dynamic change among the individuals for the inherent practices that are followed in the organization, which was not there in the previous management. Further, there is an increase in the safety-critical equipment. In this way, a strategic shift in the MNC culture has resulted in achieving the EHS goals laid by the organization, which were not there during the previous management. EHS is a continuous process with a vast scope in the form of continuously improving strategy. Let us pledge to be safe and secure others in the occupational environment by following the three factors.

ACKNOWLEDGMENTS

I thank my EHS team in the occupational environment for bringing strategic changes, which have increased safety consciousness and improved the organization's environmental culture. We further thank the present management for funding and supporting all aspects of achieving the EHS goals of the organization. Our team is always committed to applying new ideologies and practices in the working environment to improve the safety aspects of the organization.

REFERENCES

- Agarwal, P., Goyal, A., & Vaishnav, R. (2018). Chemical hazards in the pharmaceutical industry: An overview. *Asian J. Pharm. Clin. Res*, 11, 27-35.
- Assennato, G., & Navarro, V. (2019). Workers' participation and control in Italy: the case of occupational medicine. In *An International Perspective* (pp. 152-167). Routledge.
- Atalaya, O., Santillan, D., & Choque, M. (2019). Fire system for an automated electrical substation via programmable logic controller. *Advances in Science, Technology and Engineering Systems*, 4, 353-359.
- Bala, M. (2020). Role of Manufacturing Sector towards a Five Trillion Dollar Indian Economy by 2024. In *Madhu Bala* (2020, February 12). *Role of Manufacturing Sector towards a Five Trillion Dollar Indian Economy by 2024. Paper presented at seminar: Economic Slowdown in India: Causes and Consequences, Holy Cross College, Nagercoil, Tamil Nadu.*
- Bao, L., Wang, P., Dang, W., Kuang, C., & Yu, A. (2021). Experimental study on detonation flame penetrating through flame arrester. *Journal of Loss Prevention in the Process Industries*, 72, 104529.
- Bavarian, B., Zhang, J., Reiner, L., & Miksic, B. (2015). Comparison of vapor corrosion inhibitors and nitrogen blanketing systems' corrosion protection effectiveness. *Corrosion conference 2015, NACE-2015-5450.*
- Bhattacharyay, S. (2018). Foreign direct investment in India opportunities and challenges. *International Journal of Asian Business and Information Management (IJABIM)*, 9(4), 1-20. DOI: 10.4018/IJABIM.2018100101
- Bhusnure, O. G., Dongare, R. B., Gholve, S. B., & Giram, P. S. (2018). Chemical hazards and safety management in pharmaceutical industry. *Journal of Pharmacy Research*, 12(3), 357-369.
- Brooks, D., & Streng, H. (2019). The stability operations industry: The shared responsibility of compliance and ethics. In *Private Military and Security Companies (PMSCs) and the Quest for Accountability* (pp. 165-181). Routledge.
- Cheremisinoff, N. P. (2014). *Dust Explosion and Fire Prevention Handbook: A Guide to Good Industry Practices*. John Wiley & Sons.
- Chelawat, H., & Trivedi, I. V. (2016). The business value of ESG performance: The Indian context. *Asian journal of business ethics*, 5(1), 195-210.
- Chin, T., Tam, I., & Yin, C.Y. (2023). Wet scrubbing process with oxidation and reduction in series for removal of SO₂ and NO from marine diesel engine exhaust. *Chemical Engineering Journal*, 464, 142299.
- Crawley, F., & Tyler, B. (2015). *HAZOP: Guide to best practice*. Elsevier.
- Ezenwa, S., Talpade, A. D., Ghanekar, P., Joshi, R., Devaraj, J., Ribeiro, F. H., & Mentzer, R. (2022). Toward improved safety culture in academic and industrial chemical laboratories: an assessment and recommendation of best practices. *ACS Chemical Health & Safety*, 29(2), 202-213.
- Florit, F., Lunghi, A., & Rota, R. (2022). Balancing Emergency Relief System size and plant productivity in multipurpose chemical reactors. *Journal of Loss Prevention in the Process Industries*, 76, 104742.
- Hill Jr, R. H. (2020). Fire Hazards of Flammable Liquids—What Undergraduates Need to Know. *Journal of Chemical Education*, 98(1), 45-49.
- Jusoh, N., Ali, M. W., Abdullah, T. A. T., & Husain, A. (2020, April). The permit to work in relation with occupational accident at Petrochemical Plant. In *IOP Conference Series: Materials Science and Engineering* (Vol. 778, No. 1, p. 012127). IOP Publishing.
- Khair, N. K. M., Lee, K. E., Mokhtar, M., & Goh, C. T. (2018). Integrating responsible care into quality, environmental, health and safety management system: A strategy for Malaysian chemical industries. *Journal of Chemical Health and Safety*, 25(5), 10-18.
- Khan, M. A., Sun, J., Li, B., Przybysz, A., & Kosel, J. (2021). Magnetic sensors-A review and recent technologies. *Engineering Research Express*, 3(2), 022005.
- Kim, S. J., & Ham, S. (2023). Evaluation of Air Quality inside Self-Contained Breathing Apparatus Used by Firefighters. *Fire*, 6(9), 347.
- Koedel, U. et al. (2022). The Digital Earth Smart Monitoring Concept and Tools. In: Bouwer, L.M., Dransch, D., Ruhnke, R., Rechid, D., Frickenhaus, S., Greinert, J. (eds) *Integrating Data Science and Earth Science*. SpringerBriefs in Earth System Sciences. Springer, Cham.

- Lee, K., Kwon, H. M., Cho, S., Kim, J., & Moon, I. (2016). Improvements of safety management system in Korean chemical industry after a large chemical accident. *Journal of loss prevention in the process industries*, 42, 6-13.
- Liu, X., Li, J., & Li, X. (2017). Study of dynamic risk management system for flammable and explosive dangerous chemicals storage area. *Journal of Loss Prevention in the Process Industries*, 49, 983-988.
- Mearns, K. (2017). Human factors in the chemical process industries. In *Methods in Chemical Process Safety* (Vol. 1, pp. 149-200). Elsevier.
- Nguyen, H. T., Safder, U., Kim, J., Heo, S., & Yoo, C. (2022). An adaptive safety-risk mitigation plan at process-level for sustainable production in chemical industries: An integrated fuzzy-HAZOP-best-worst approach. *Journal of Cleaner Production*, 339, 130780.
- Nwankwo, C. D., Theophilus, S. C., & Arewa, A. O. (2020). A comparative analysis of process safety management (PSM) systems in the process industry. *Journal of Loss Prevention in the Process Industries*, 66, 104171.
- Oldenkamp, R., Hamers, T., Wilkinson, J., Slootweg, J., & Posthuma, L. (2024). Regulatory risk assessment of pharmaceuticals in the environment: Current practice and future priorities. *Environmental toxicology and chemistry*, 43(3), 611-622.
- Pearson, M., & Martinez Fonte, D. (2023, August). Use of Remotely Operated Shut-Off Valves for Emergency Isolation of Pressure Vessels and Hazardous Fluids. In *Conference of Metallurgists* (pp. 107-119). Cham: Springer Nature Switzerland.
- Poddar, N. (2019). A study on mergers and acquisition in India and its impact on operating efficiency of Indian acquiring company. *Theoretical Economics Letters*, 9(4), 1040-1052.
- Powell, J. A. (2023). Importance of Maintaining Laboratory Emergency Equipment— Showers and Eyewashes. *ACS Chemical Health & Safety*, 30(4), 179-181.
- Promsawat, T., Kummool, S., Pongswatd, S., & Julsereewong, A. (2016, October). Real-time monitoring and reporting alarm system for pH measurement in wet scrubbers. In *2016 16th International Conference on Control, Automation and Systems (ICCAS)* (pp. 353-358). IEEE.
- Qian, Y., Vaddiraju, S., & Khan, F. (2023). Safety education 4.0—A critical review and a response to the process industry 4.0 need in chemical engineering curriculum. *Safety science*, 161, 106069.
- Ramaswamy, K., Jule, L.T., Nagaprasad, N., Subramanian, K., Shanmugam, R., Dwarampudi, L., & Seenivasan, V. (2022). Reduction of environmental chemicals, toxicity and particulate matter in wet scrubber device to achieve zero emissions. *Sci Rep.*, 12, 9170.
- Rantanen, J., & Khinast, J. (2015). The future of pharmaceutical manufacturing sciences. *Journal of pharmaceutical sciences*, 104(11), 3612-3638.
- Rao, P. K., Pandey, G., & Tharmavaram, M. (2020). Chemical evidences and their handling. *Technology in Forensic Science: Sampling, Analysis, Data and Regulations*, 79-99.
- Rao, A., Dagar, V., Sohag, K., Dagher, L., & Tanin, T. I. (2023). Good for the planet, good for the wallet: The ESG impact on financial performance in India. *Finance Research Letters*, 56, 104093.
- Robson, L. S., Amick III, B. C., Moser, C., Pagell, M., Mansfield, E., Shannon, H. S., ... & South, H. (2016). Important factors in common among organizations making large improvement in OHS performance: results of an exploratory multiple case study. *Safety science*, 86, 211-227.
- Sankaran, A., Vadivel, A., & Jamal, M. A. (2020). Effects of dynamic variables on industrial output in one of the world's fastest-growing countries: case evidence from India. *Future Business Journal*, 6(1), 15.
- Sharma, P., Panday, P., & Dangwal, R. C. (2020). Determinants of environmental, social and corporate governance (ESG) disclosure: a study of Indian companies. *International Journal of Disclosure and Governance*, 17(4), 208-217.
- Slunge, D., & Alpizar, F. (2019). Market-based instruments for managing hazardous chemicals: A review of the literature and future research agenda. *Journal of Sustainability*, 11(16), 4344.
- Sun, Q., Jiang, L., Li, M., & Sun, J. (2020). Assessment on thermal hazards of reactive chemicals in industry: State of the Art and perspectives. *Journal of Progress in Energy and Combustion Science*. 78, 100832.
- Teuchies, J., Cox, T.J.S., Van Itterbeeck, K., Meysman, F.J.R & Blust, R. (2020) The impact of scrubber discharge on the water quality in estuaries and ports. *Environ Sci Eur.*, 32, 103.
- Trifu, A., Darabont, D. C., Ciocirlea, V., & Ivan, I. (2024). Advantages and disadvantages of the online training system in the field of occupational safety and health. In *MATEC Web of Conferences* (Vol. 389, p. 00048). EDP Sciences.
- Villa, V., Paltrinieri, N., Khan, F., & Cozzani, V. (2016). Towards dynamic risk analysis: A review of the risk assessment approach and its limitations in the chemical process industry. *Safety science*, 89, 77-93.
- Viswanathan, S. (2011). Occupational health and safety in chemical industries in transitional economies. *Indian Journal of Occupational and Environmental Medicine*, 15(3), 85-86.
- Wang, L.K., Taricska, J.R., Hung, Y.T., Eldridge, J.E., Li, K.H. (2004). Wet and Dry Scrubbing. In: Wang, L.K., Pereira, N.C., Hung, Y.T. (eds) *Air Pollution Control Engineering. Handbook of Environmental Engineering*, vol 1. Humana Press, Totowa, NJ.
- Wang, B., Yun, M., Liu, Q., & Wang, Y. (2023). Precision safety management (PSM): A novel and promising approach to safety management in the precision era. *Journal of safety science*, 157, 105931
- Yang, U. (2023). Compact near-eye display for firefighter's self-contained breathing apparatus. *ETRI Journal*, 45(6), 1046-1055.
- Yanisko, P., Zheng, S., Dumoit, J., & Carlson, B. (2011). Nitrogen: A security blanket for the chemical industry. *Chemical Engineering Progress*, 107(11), 50-55.