

***Safety performance improvement
through***

***Safety Cultural Transformation –
An Initiative with DuPont***



Brief about Company

L&T Hydrocarbon Engineering is an ISO 45001:2018 and ISO 14001:2015 certified organization with in-house capabilities in Engineering, Project Management, Procurement, Fabrication, Installation, Hook-up and Commissioning, LT&HE provides turnkey solutions to the Upstream Hydrocarbon Industry, encompassing Production, Processing and Transportation.

L&T has successfully delivered EPIC services for many projects in the offshore hydrocarbon sector over the last two decades, in India, Middle East, Africa, South-East Asia and Australia to reputed international companies like ONGC, British Gas, Songas, Qatar Petroleum, GASCO, Petronas, Shell, MODEC, Technip, Maersk Oil and Bunduq.

Oil and Natural Gas Corporation Ltd. (ONGC), has taken up additional development of Cluster-7 and Cluster-8 fields for production of well fluid and integrate it with existing field network. Cluster-7 and Cluster-8 marginal fields as part of Mumbai High Asset are in the BH-DCS block of Mumbai offshore Bassein at about 210 km to the west of Mumbai city and are about 20 to 40 kms to the south-west of Mumbai High field.

Being the contractor for Cluster 8 Marginal Field Project, L&T Hydrocarbon Engineering has safely completed laying of 7 Pipeline Segments (10", 8" and 6") for Well fluid, Water Injection and Lift gas in season 2019-2020 with 549120 LTI free safe manhours. Pipeline installation carried out with L&T Hydrocarbon Engineering owned vessel LTB-300 (IMO: 8536471, MMSI 419901983) which is a Pipe Layer built in 2010 and currently under the flag of India.

Adapting digitalisation and cutting-edge innovation, L&T Hydrocarbon Engineering delivered technologically superior solutions at every phase of project execution leading to timely completion of pipeline installation job.



LTB-300 PIPELAY BARGE



Background: Finding

Construction industry jobs have traditionally been considered hazardous ones, due to the high incidence of occupational injuries and, above all, fatalities. The International Labour Organization estimates that at least 60,000 fatalities occur at construction sites annually around the world. This means that one fatal construction-related accident occurs approximately every ten minutes, which also means that around 17% of all work fatalities (one in every six) are in this industry.

As a part of our ambitious Lakshya 2015 journey, we needed to take critical steps to achieve sustained safety performance through 'Enhanced Employee Behaviour for Safety'. We have partnered with DuPont Sustainable Solutions to facilitate 'Safety performance improvement through Safety Cultural Transformation' across the organization.

The Larsen & Toubro Hydrocarbon Engineering safety transformation journey started in 2011. Prior to that and common in many organizations, safety was the sole responsibility of the safety department. It was also the time when the company was experiencing double-digit Lost Time Injury numbers annually. Line managers were not directly responsible for safety and often not equipped to enforce compliance with safety rules and regulations. Other challenges included; an "it's ok" attitude; a resistance to change; and different standards applied on LTHE project sites versus those required by the industry.

Using other global industry leaders' safety challenges and solutions as a benchmark, LTHE selected DuPont to help instil a culture change and a safety mindset. Decision was based on DuPont's extensive experience, its reputation for being one of the safest companies in the world, its shared belief in the philosophy that "all injuries are preventable" and DuPont's proven model to achieve world-class performance through behavioural change and reduction in injuries. LTHE employees worked alongside DuPont to create and implement a solution that maximized LTHE's strengths.

Solutions

For any vision to be realized, we knew a robust process and action plan was required. Using DuPont techniques to drive the plan, we began to effect changes in behaviour and mindset. Consistency and passion were two by-words for success.

A three-pronged plan was put into effect to transform the "basic DNA" of LTHE safety performance, especially among the workforce.

Phase 1: Containment

The immediate priority was to contain the injuries and fatalities. This was achieved through focused deployment of resources for quick results, including:



- Auditing of project, identifying and correcting safety violations
- Introducing safety briefings prior to work commencement as a standard procedure
- Sharing of job hazards and preventive measures
- Implementing compulsory training and induction
- Involving workers in safety management
- Conducting mass meetings with a large number of workers to assure consistency of message and agreement for compliance.
- Setting standards for immediate high risk, high hazard potential activities and bringing the exposure to hazards within acceptable levels

Phase 2: Establishing systems and processes

To reduce injuries and keep workers safe is to first manage the system. When in place and embraced by workers, these systems change the safety culture so that lasting change can take root.

Some of the key steps taken to make safety culture a way of life at LTHE included:

- Driving effective Sub-contractor safety through “Sub-Contractor Management Procedure”
- Establishing location/ job-specific training processes
- Initiating Field Safety Audits
- Having same safety metrics for LTHE employees

Phase 3: Sustaining the Safety Way:

Continuous improvement of a safety culture requires ongoing strengthening of policies and procedures, training and motivation, accountability, and employee buy-in. Safe behaviours instilled at work are carried home, which influences the community.

Safety is a journey, not a destination and continuing this journey is critical. The planning must be thorough, just as you would plot your own trip, and recalculating could be necessary so that progress toward your goal is not thwarted.



To keep up the momentum, measures were taken to drive safety culture momentum including:

- Operating discipline – doing it right each time by one and all
- Rewarding and recognizing positive safety behaviour
- Taking preventive and corrective actions to reduce and contain non-compliance
- Conveying the message of “we care for you” and demonstrating the message through actions
- Monitoring of “Leading Indicators”, such as Good Citizens or Safe Act Index

Implementation

While processes and standards continued to be put in place and corrective actions taken, LTHE continued to experience resistance to change in the organization. Some leadership team members were expecting to see quick results and were unsatisfied over continued injuries and the perceived lack of improvement, despite time and efforts invested. Some contract workers and employee were still stuck in the “it’s ok”, “it won’t happen to me” mindset.

One of the key turning points came through the creation of model project sites. Instead of instilling change all at once in all the sites, a handful was selected as model sites. Efforts were focused on having the supervisors trained on and aware of the safety standards. In addition, there was recognition that the contract workers have a different level of understanding and efforts were made to reach their level of understanding. As a result, standards were implemented faster and when people see results, they become believers and, importantly, advocates.

The model site was a catalyst for significant improvement. Once people realized what their peers could accomplish, they wanted to be part of it. In fact, some sub-contractors were quite enthusiastic and went ahead to form their own ‘integrated safety organization without any prodding by our LTHE team.”

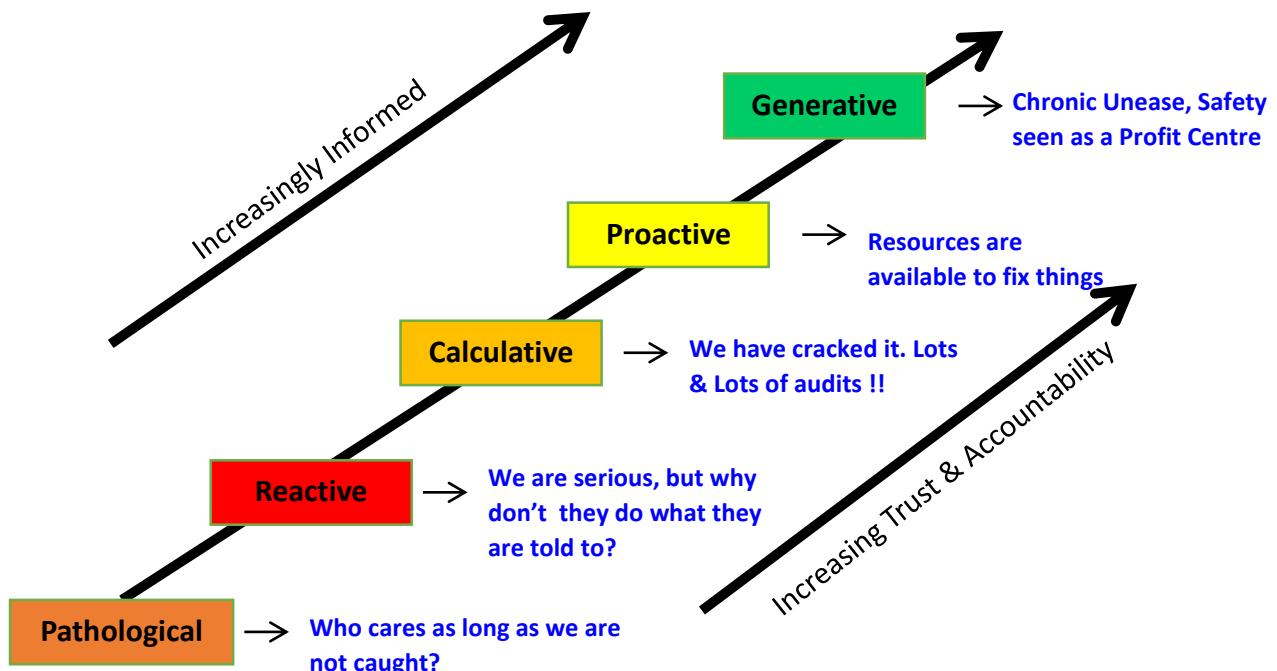
This healthy competition between project sites has also helped to raise the bar even higher and provided motivation to LTHE’s employees.

Workshop on “Leading Safety Efforts”:

The journey with DuPont started with Leading Safety Efforts Workshop conducted from 7th to 9th Mar 2011, attended by the senior and line management from our yards as well as project and site construction teams.

As a part of the workshop, participants conducted field safety observations reinforcing positive safety behaviour, establishing standards and motivating people. The participants also got acquainted with the constituents of a good safety organization.

Safety Culture Ladder: Hearts & Minds



Risk Containment Phase Kick Off:

The workshop was followed by Risk Containment Phase. Kick Off for this phase took place from 7th to 9th May 2011 at MFY Sohar and 12th to 14th May at MFF Hazira with representation from higher/ middle management to bring in alignment at different levels.

Areas of high risk were identified as critical to our operations such as Heavy vehicular movement, Hydrotesting, Working at height, Material handling, Electrical safety, Working in confined space, Equipment loading and gas cylinder handling. The workout also focussed on customized containment approach of these high-risk activities leading to action plan development, governance structure facilitation and safety field audit.

Risk Containment Common Phase:

The Risk Containment Common Phase was held from 16 May to 18 June 2011 to develop 8 draft standards to take care of the safety concerns of identified high risk activities/ areas. Representation from all units was ensured while developing the standards in consultation with DuPont experts. These standards are presently reviewed by a separate team to make them applicable to all operations of our Hydrocarbon IC.



Risk Containment Implementation Phase:

The risk containment implementation phase started from 9th July and will span over six months to conclude on 21st Dec 2011 at MFF & MFY (Fabrication Yards). DuPont experts have an intensive involvement along with our operating personnel. The implementation phase will include upgrading L&T's safety standards to incorporate best practices and running short training modules for each of the high risk activities in line with standard requirements.

It will lead to line management accountability by accounting leading & lagging metrics. The Safety Field Audits (SFA) with corrective actions will benchmark the performance index and timely close out of outstanding issues.

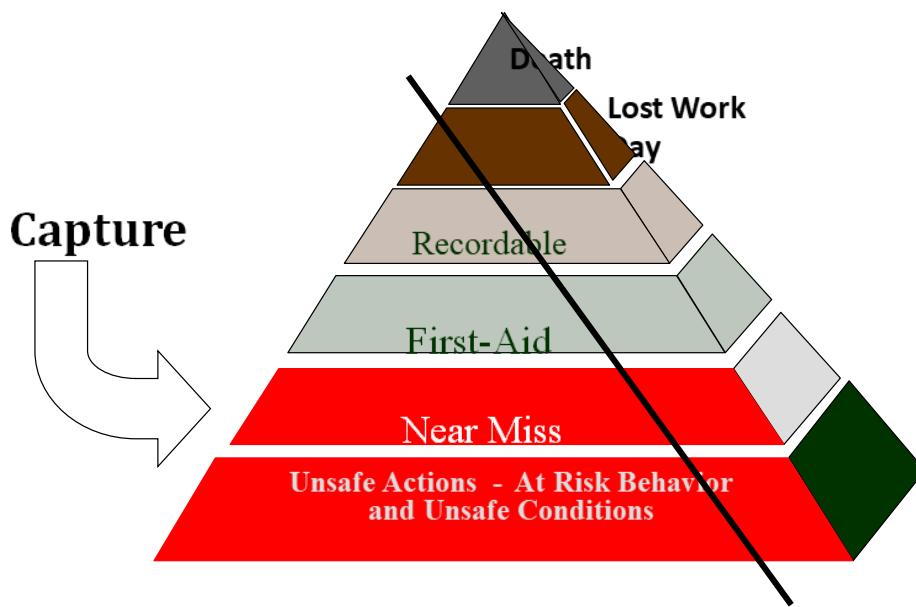
Governing Structure:

To establish a governance structure at Corporate and units level Apex Committee and Risk Containment Committees (RCC) have been formed.

Apex Committee reviews and approves HSE proposals/ standards developed by RCCs, set clear guidance on scope and timing and regularly review the progress of the Risk Containment Program.

Risk Containment Committee sets up systems to ensure compliance with the safety standards and set up key performance indicators in the respective units / subunits. It also collects safety related data to monitor the trend of KPIs, audit the respective areas/ area owners, discuss high risk findings and generate feedback reports for reviews.

RCCs have been already formed at Sohar and Hazira (Chart 2 and 3) and regular meetings are taking place. Apex committee meeting is scheduled on 3rd Aug 2011 with appropriate involvement of senior DuPont consultants.



Construction sites

To cascade this movement further in our construction sites, Leading Safety Efforts workshop was conducted first at our site in Mangalore followed by our site at Bharuch. As a part of these programs, field exercises on "Safety Observation" and "Safety Contact" were held at Project sites.



A detailed action plan, based on these workshops which included various measures to popularise participation of all in safety movements was derived. This will be followed in other construction sites of our IC with a structured time bound program.

In process of improvement we set framework for Risk Management in Structure and Pipelay Installation, Identifying hazards and analysing their potential effects, assessing the risks against the Industry criteria, installing control measures to reduce risks to tolerable level are essential requirements for proactive HSE management. In order to make a value judgement and to decide on what risks are tolerable, an easily understood set of criteria should be set and followed rigorously. Risk criteria are required to promote consistency in evaluating the results of relevant safety studies and to formulate a proactive approach to accident and incident prevention.

RISK MANAGEMENT @ STEP 1 - HAZID FRAMEWORK ([STRUCTURAL INSTALLATION / PIPELAY INSTALLATION](#) / SUBSEA / PRECOMMISSIONING)

| SEVERITY TABLE | | FIXED CRITERIA | | | CRITERIA MAY ALTER BASED ON PROJECT-BY-PROJECT BASIS | |
|--------------------------|--|---|--|---|---|--|
| SEVERITY CRITERIA | HARM TO PEOPLE (INJURY / HEALTH) | DAMAGE (SAFETY) | ENVIRONMENT | PROJECT SCHEDULE | FACILITY AVAILABILITY | |
| 5 CATASTROPHIC | Multiple Fatalities/Multiple Serious Injuries. Likely to prevent operational Safety Case acceptance | Over \$ 500,000 Extensive damage (multiple fires/explosions) or loss of installation | Massive & uncontrolled release with significant environmental impact extending well beyond site boundary. Chronic pollution resulting in damage lasting more than 12 months | Schedule impacted+7 days | Production revenue loss is more than 1 month. | |
| 4 SEVERE | Single Fatality. Injury resulting in permanent and severe disability. May prevent Operational Safety Case acceptance | More than \$150,000 less than \$500,000 Damage extending to several areas/significant impairment of installation/equipment integrity | Extended exceedance of license conditions & / or uncontrolled release. Significant environmental impact beyond the site boundary unlikely to last beyond 12 months. Recovery/rehabilitation requires external assistance | Schedule impacted more than 48 hours but less than 7 days. | Production revenue loss is more than 1 week but less than 1 month | |
| 3 SIGNIFICANT | Day Away from Work case (DAFWC) Temporary or permanent partial disability | More than \$75,000, less than \$150,000 Significant damage to local area or essential plant & equipment | Outside the site boundary. Localized pollution giving rise to significant environmental impact but unlikely to last beyond 1 month. Repeated exceedance of license conditions recovery/rehabilitation may require external assistance. | Schedule impacted more than 12 hours but less than 48 hours | Production revenue loss is more than 1 day but less than 1 week | |
| 2 MODERATE | Medical Treatment / Restricted work Case | More than \$25,000, less than \$75,000 Limited damage to plant & equipment | Within site boundary. Short term environmental impact. Single license exceedance recoverable by worksite. | Schedule impacted more than 1 hour but less than 12 hours. | Production revenue loss is more than 12 hours but less than 1 day | |
| 1 NEGLIGIBLE | First Aid Injury | Less than \$25,000 Insignificant damage to plant & equipment | Within site boundary. No significant environmental impact or exceedance of license conditions. Easily controlled /recovered/recovered by worksite. | Schedule impacted up to 1 hour | Production revenue loss is less than 12 hours | |



RISK MANAGEMENT @ STEP 1 - HAZID FRAMEWORK

| PROBABILITY TABLE | PRE-MITIGATION (EXISTING CONTROL MEASURES) | POST-MITIGATION (with additional control measures) |
|--------------------|---|--|
| A Very Unlikely | To the best knowledge of the risk assessment team the hazard has not occurred within industry | It is considered a freak combination of factors would be required for the hazard to occur at any time |
| B Unlikely | To the best knowledge of the risk assessment team the hazard has occurred within industry at least once | A rare combination of factors would be required for the hazard to occur during the course of the work. |
| C Possible | To the best knowledge of the risk assessment team the hazard has occurs annually within industry & / or LTHE | Could happen when additional factors are present but otherwise unlikely to occur during the course of the work |
| D Likely | To the best knowledge of the risk assessment team the hazard regularly occurs more than once a year in LTHE | It is considered likely the hazard could still arise during the course of the work. |
| E Very Likely | To the best knowledge of the risk assessment team the hazard is predicated to occur at least once during course of the work unless changes are made | Almost inevitable the hazard will occur during the course of the work. |

Risk Table (R = R1 X

| | 5 | 5A | 5B | 5C | 5D | 5E |
|---------------------------|---|----|----|----|----|----|
| Severity Rating (R2) → | 4 | 4A | 4B | 4C | 4D | 4E |
| | 3 | 3A | 3B | 3C | 3D | 3E |
| | 2 | 2A | 2B | 2C | 2D | 2E |
| | 1 | 1A | 1B | 1C | 1D | 1E |
| Probability Rating (R1) → | A | B | C | D | E | |

Risk Score and Its Classification

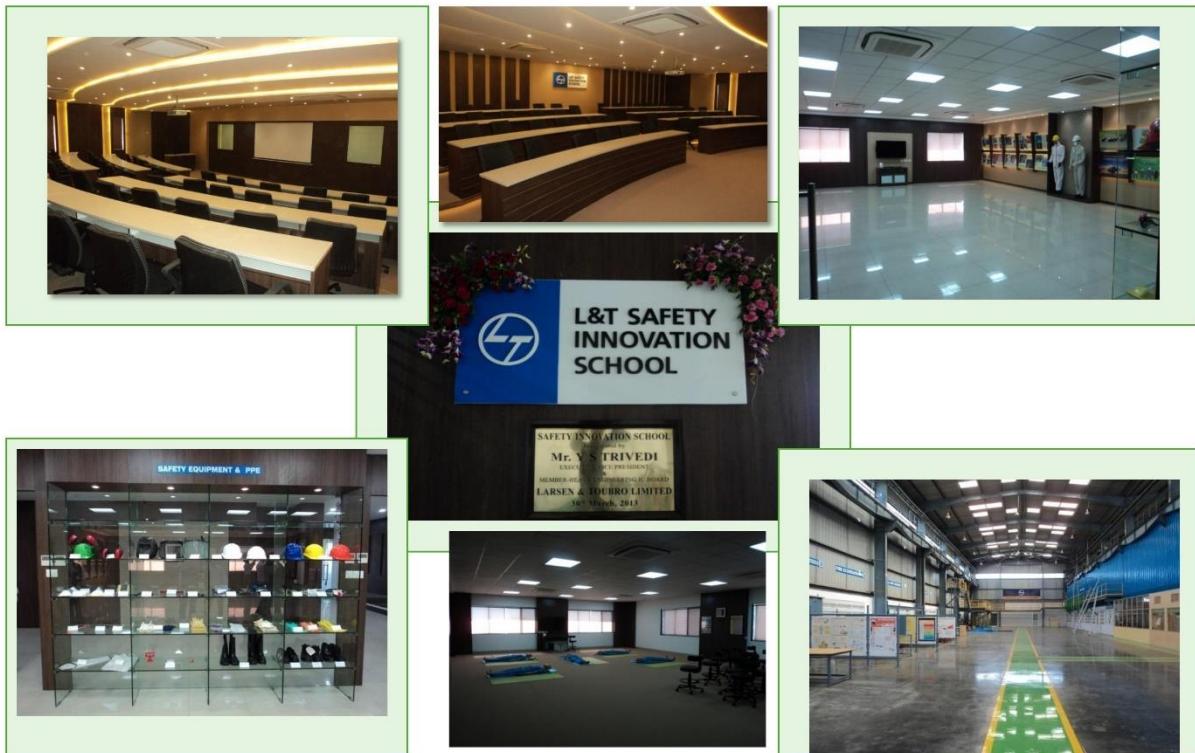
| RISK SCORE | RISK CLASSIFICATION |
|--------------------------------------|-----------------------------------|
| 1A-3A; 1B-2B; 1C | LR: Low Risk |
| 4A-5A; 3B-4B; 2C-3C; 1D-2D; 1E | MR: Medium Risk (ALARP Region) |
| 5B, 4C-5E; 3D-5D; 2E-5E | HR: High Risk (Unacceptable Risk) |

Achievements:

Between 2011 and 2016, LTHE implemented a variety of creative safety initiatives, including an Online Incident Reporting System to capture incidents or near misses, so that their cause(s) could be identified, and suitable preventive and corrective measures taken.

Our vision is Zero Incident Credo. Any safety effort – including those based on behaviour-based safety approaches – is doomed to failure unless management leads and supports the effort. That's because employees must be able to look to management for leadership. They must believe that their managers place a high priority on safety and that they are willing to live according to safety principles too. They must understand that safety, not business, is management's top priority, so they'll make safety their own initiative.

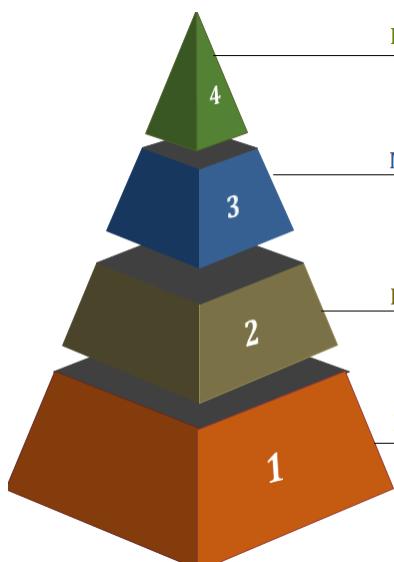
Safety Innovation school was the unique conception introduced in the year 2012 for enhancing Safety training across LTHE and is the biggest achievement. SIS at Hazira is one of the very few such facilities in India for providing excellent Safety Training (both classroom & Practical) with innovative programs like 3D simulations, CPR techniques, Experiential Learning etc. This program is designed for 3days, with the target group of Senior Managers, Construction Managers, Engineers, Supervisors and also Supervisor/Safety marshals of subcontractors.



Long Term Planning

Industry 4.0 - The Future of OHS Management at Offshore

- Digitalization Journey at LTHE started in early 2017, with evaluation of existing IT solutions for Project management requirements and identification of potential areas for Digitalization.
- Formulated 4-Tiered modular roll-up of Digitalization initiatives across EPC value chain in all verticals.
- Delivered many Digital Solutions to improve Health, Safety and Worker Productivity at Projects.



Module 4: Cognitive, AI & Knowledge Management

- Transforming Knowledge Management through cognitive and artificial intelligence capabilities (situational guidance, prescriptive/predictive analytics etc.)

Module 3: Productivity Improvements / "Edge" Applications

- Technology improvements to enhance resource utilization at Sites & Fabrication Yards (workmen productivity, DPR, barcoding etc.)

Module 2: New Dimensions & Analytics

- Transformational Capabilities (multiD modelling, cost and schedule integration etc.)
- Analytics and dashboards (cost to completion, project dashboard etc.)

Module 1: Existing System Enhancements

- Incremental enhancements to existing platforms
- Aligning them with future "Digital landscape" requirements

Digital Drive in HSE



Offshore Oil & Gas Platforms are High Risk Zones, "Studies have shown, up to 90% of O&G accidents are attributable to some degree of human error/failure"

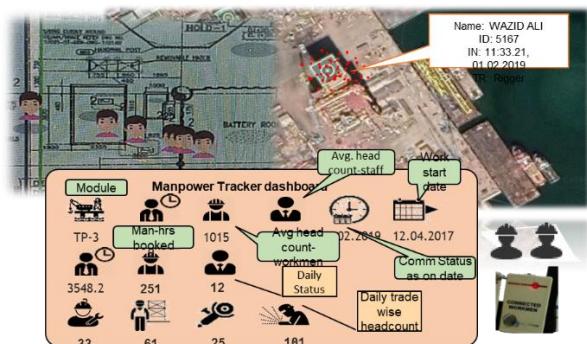
Hence, technological intervention is the need of the hour.

We found following are the Hazards to Offshore Workmen:

- Fires & Explosion due to hydrocarbon egress
- Falls from deck & Falling Tools from upper level
- Harm from Machinery & Equipment
- Unpredictable weather & wind patterns
- Gas Leakage and Sulfide environment
- Medical Emergency Bottlenecks
- Strenuous & high-noise environment
- Fatigue due to long working hours
- Capsizing and submerging of structure

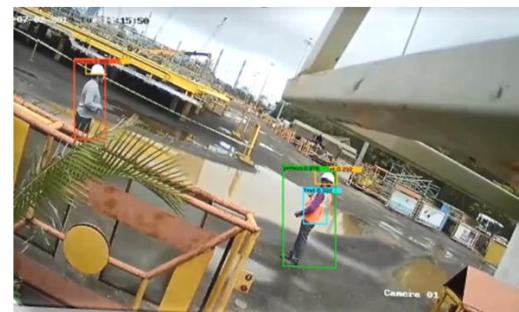
We took following Initiatives:

"Connected Workers – using Smart Solutions"



Scope/Coverage:

- Smart Wearable given to Workers
- Active RFID/LORA based Worker Tracking
- Provides real-time worker movement at Offshore and Yards
- Video analytics for Worker PPEs
- Coverage more than 2000 nos. of Workers



Key Benefits:

- Improved HSE Monitoring
- Realtime PPE tracking & alert management
- Real-time Work-Zone availability status
- Better rescue management
- Auto worker record during mock-drill



Connected Workers – Replacing Manual Tracking with Auto

Current System at Offshore Oil Platform

Man Power Chart

| DATE :- 01/04/19 | |
|------------------|------------|
| LTHE | 15 |
| ONGC | 01 |
| VCS | 02 |
| DNV | 04 |
| VENDOR | 08 |
| MATHEWS | 177 |
| TOTAL | 268 |
| Welder | 16 |
| Fitter | 09 |
| Grinder | 07 |
| Gas Cutter | 04 |
| Fireman | 12 |
| Safety Officer | 03 |
| Supervisor | 04 |
| Scaffolder | 33 |
| Rigger | 13 |
| Helper | 19 |
| AARAKAY | 26 |

- No Real-time Visibility on Zone Wise Worker Location
- Manual Time Sheet and Head count in Mustering

- Real-time Visibility on Zone Wise Worker Location
- Auto Generation of Time Sheet and Head count in Mustering

Connected Machines – Realtime Fuel Consumption tracking

Scope/Coverage:

- Material Handling Equipment's at Projects Sites
- Vessels, Barges in marine Services
- Coverage of Welding Machine, Cranes, DG sets etc.

ROI/Potential Benefits

- Improved asset utilization and tracking
- Notifications for abnormal fuel consumption / fuel pilferage
- Alert to maintenance
- Real-time Efficiency management of assets



QHSE Induction & Training : VR/AR



Benefits :

- Improved HSE Induction
- Behavior based site training
- Real-time remote assistance over Cloud
- Real-time monitoring and vendor support

Scope/Coverage:

- Smart Glass for Remote Inspection management at Hazards Zone
- AR/VR Apps for Virtual Training to Worker
- E.g. Work at Heights & Loose Material Control



Prevention is Better and Cheaper than Cure after any Incident occurs at Site

We are in process of improvement and bringing more solutions and initiatives in the field of digitilization in HSE.

Driving transformation by focusing on risk reduction, strengthening safety culture, and embedding a sustainable operating rhythm. Sustainable risk reduction and operational performance improvement are two sides of the same coin. A cultural transformation and operational performance improvement program is a “marathon” and not a “sprint”, and needs to be resilient during organisational changes. Transformation and pace of change need to take into account risks, maturity of the organisation, capabilities, and constraints.

LTHE is committed for continual improvement and sustainable safety culture with people as prime movers.