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Influencing Health & Safety with Information Technology

Perez, Eugine A., Thinyan, Khalid T., Shahri, Abdullah
Area IT Dept. Saudi Aramco

Abstract:- Information Technology (IT) plays a huge role in the field of Health, Safety, and Environment (HSE). But this is still somehow a vague or general statement. New technologies are now adopted in practicing HSE by companies and professionals of different industries. This is because of its proven efficiency and reliabilitylimiting human error by eliminating human interface and providing smart technologies.Different companies including Saudi Aramco invest in these various smart safety solutions as part of embracing digital transformation to increase the level of safety, reduce or eliminate risks to their people, and protect company assets. These new technologies are being used to proactively prevent or at least reduce the possibility of accidents from happening.

I. INTRODUCTION

Companies are applying new technologies because of the positive effects on life productivity, efficiency, and safety. It is significant to note that recent innovations in technology can provide massive benefits to health and safety practices that have been established within the workplace.

In the Oil and Gas industry, digital technologies and smart safety solutions are being popularly used or have an upward trend of usage. In an article Digital Technology Trends in the Oil and Gas Industry, it identified key digital technologies in oil and gas industry. Artificial Intelligence and Automation, Big Data and Data Analytics, Internet of Things (IoT) and Electronic Monitoring, 3D Virtual Modelling and Drone Technology, were highlighted as well as how they can be applied. [1] And now, it is evident in most oil and gas companies that these new digital technologies are being used with Health & Safety as one of the reasons of implementation.

IT substantially offers a variety of safety solutions that can resolve major safety issues and promote accident prevention. Countless accidents with injuries or loss of lives have been prevented. The use of new IT solutions within safety as a preventive tool will topple the observed inconsistent rate of worker injuries and fatalities in the industry. These technologies can be applied as the first barrier to either protect workforces from hazards or help identify workplace hazards therefore raising survivability. The implementation of these solutions in different fields is required to enhance safety culture and performance.

In several articles, it is commonly observed that human error is one of the main contributors or causes of accidents. [2]In a study done by the Health & Safety Executives (HSE), it stated that "it is estimated that up to 80% of accidents may be attributed, at least in part, to the actions or omissions of people." [3]A research firm, ARC Advisory Group study has operational or human error as the primary cause in 42%of the cases [5]and identified that a more comprehensive or integrated IT solution approach must be developed if the industry is to achieve a breakthrough in improving safety. One of the proposed solutions was a fully-automated solution which eliminates the human factors altogether [4].

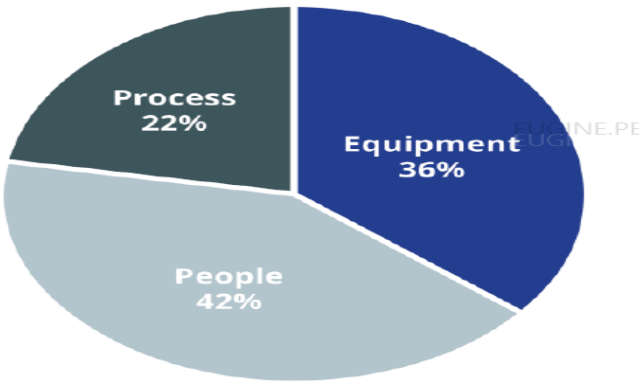

Fig. 1: Primary categories of causes for abnormal process events. [5]

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A survey was conducted in construction industry with one hundred two participants. All participants were given a list of top potential benefits of identified technologies as shown in the table and percentage of responses for each of the benefits.[6]

Here are some of the technologies significantly utilized to improve Safety.

BENEFITS OF TECHNOLOGIES USED FOR OSH MANAGEMENT

Safety benefits of technology	No. (%) responses
Improve worker awareness of hazard	83 (81%)
Warn workers of workplace hazards	55 (54%)
Eliminate hazard during design	55 (54%)
Help visualize workplace hazards	55 (54%)
Enhance effectiveness of safety training	40 (39%)
Enhance incident investigation	39 (38%)
Isolate workers from hazard	35 (34%)
Facilitate injury reporting	36 (35%)
Improve safety planning	35 (34%)
Enhance communication between workers	33 (32%)
Improve safety inspections and monitoring	31 (30%)
Enhance near-miss reporting	26 (25%)

Note. $n = 102$

Table 1: Benefits of Technologies Used for OSH Management, A. A. Karakhan et al., PSJ Dec 2021 p.23. [6]

II. ROBOTICS AND DRONES

Robotics are widely used in different industries especially in manufacturing, processing, and sometimes even in the medical industry. "George Devol and Joseph Engelberger developed the first industrial robot in 1959. Unimation, USA, installed the first industrial robot at General Motor in 1961. The world's first industrial robot was used on a production line at the GM Ternstedt plant in Trenton, NJ, which made door and window handles, gearshift knobs, light fixtures and other hardware for automotive interiors."[7]

Robotics combined with automation and artificial-intelligence can do a lot work that are too complex and poses serious dangerous risks to humans. "Robots are already a part of our lives. Industrial robots are widely used in manufacturing. Military and police organizations use robots to assist in dangerous situations. Robots already have a significant role in medicine. Robots are helping doctors achieve more precision in the operating room, performing safer, less invasive techniques. Future uses of robots are not limited to "operative" tasks in manufacturing."[7]In the current generation of new advanced technology, the use of robots significantly reduces workplace injuries.Saudi Aramco now uses robots in the field to conduct inspections, firefighting, and other live-streaming of events.

Similarly, Unmanned Aerial Vehicle or also known as "Drone" are being utilized to reduce exposure to risk that humans needed to take in order to execute certain task/s. Use of drones, similar to other technologies, poses other risk that can be mitigated through engineering and administrative controls. Oil and Gas companies like Saudi Aramco opt to use drones in selected and assessed tasks like surveying, inspections, emergency response live-streaming for monitoring purposes, etc.Use of drones in the workplace has allowed businesses to access dangerous areas, such as those that are too hot, cold, or small for employee access. Reducing the risk to the workers the drones can collect the required data and deliver it timely. drones cleverly are becoming more essential to the workplace helping to prioritize health and safety.

III. UNMANNED AERIAL-UNDERWATER VEHICLE (UAUV)

Aside from drones and unmanned underwater vehicle, further research and developments had been made to integrate both concept in one platform, capable of flying in the air and submerging in to underwater, this is the Unmanned Aerial-Underwater Vehicle (UAUV). For the development of an UAUV multi-rotor configuration, at least four (4) prototypes came out.[8]as shown in Figure 3 below.

With its integrated technology concept, such invention will be of great value not only in companies' operations but also in health and safety. Safety always look at the prevention of loss of life and keeping people from harm and danger. This technology will do exactly what Safety means. It will eliminate or reduce risk/s involved in diving operations. It can do task/s of long period compared to divers who are only allowed underwater in short duration due to human body limitations underwater. In Saudi Aramco, such technology will have several use including offshore emergency response, spill emergency response, underwater installation inspections and surveying, data gathering, and more high-risk activities.

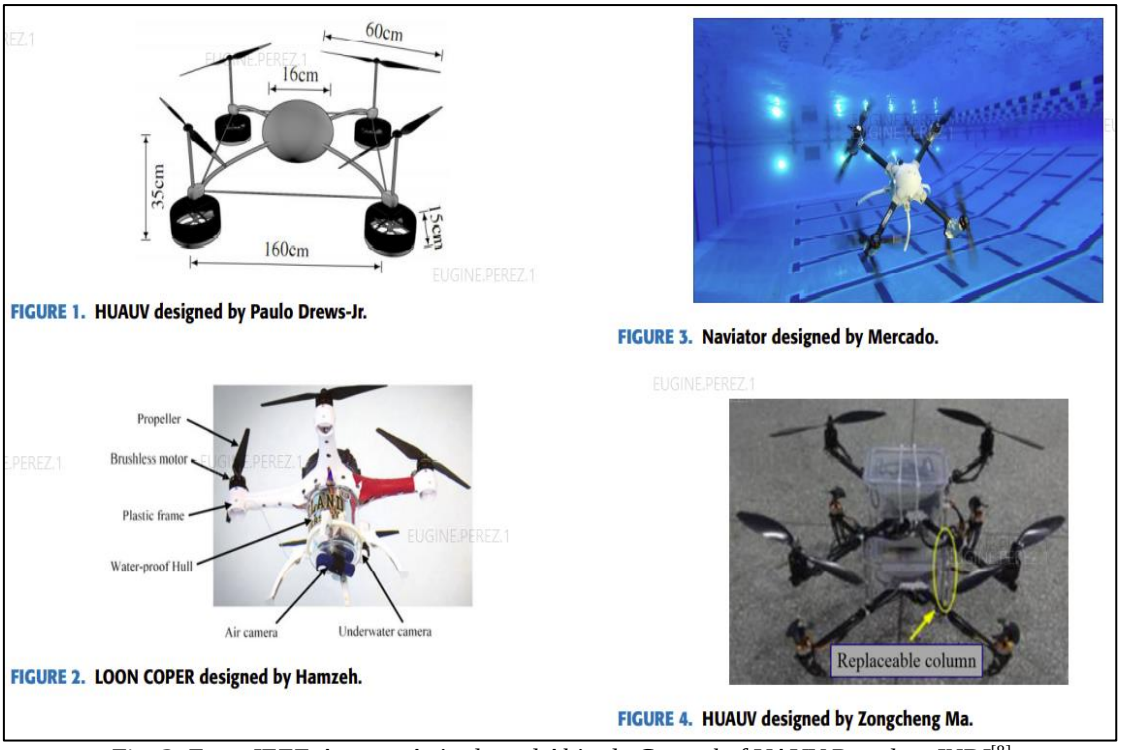

Fig. 2: From IEEE Access, *Attitude and Altitude Control of UAUV Based on INDI*[8]

IV. VIRTUAL REALITY (VR)

The value of virtual reality comes from simulating environments, and this has become very useful for safety training. There are three variations of virtual reality (VR): First is the non-immersive VR closely resembles a traditional video game; (2) Semi-immersive VR systems closely resemble the typical flight simulator; and (3) the fully-immersive VR system generally surrounds the wearer using a headset/goggles that provides the 3D display and removing the wearer from the physical environment and increasing the sense of presence within the VR environment.[9]The biggest benefit to incorporating VR into your safety program is that employees can learn while remaining 100% safe. This provides a huge advantage in both reduction of injuries as well as the prevention of damage to equipment.That benefit comes along with other several benefits including high-cost trainings, travel expenses to attend trainings, time consumed by the trainee and trainer, and possibly expensive training materials. Virtual Reality (VR) provides the best tools for accident reconstruction, training, and hazard identification by immersing the trainee in an environment as close to the real world as possible. The use of high-quality three-dimensional graphics, sound and dynamics simulation combine to form a uniquely engaging experience.[10]Saudi Aramco had engaged itself in utilization of different variants of Virtual Reality systems in several aspects and primarily in training. Led by the company's Subject Matter Experts, these VR simulations have been enhanced and tailored to ensure compliance with Saudi Aramco standards and international standards.

V. MOBILE SAFETY APPS

During the peak of the COVID-19 pandemic where there were lockdowns and several restrictions all over the world, several mobile apps have emerged significantly. Some were specifically developed for the health and safety of the public. There were mobile apps developed to track COVID-19 infections giving alerts when a person is in locations where there is high rate of COVID infection, or the person has been in close proximity with an infected individual, there were also mobile apps that logs and updates vaccination status that had to be verified when entering facilities or establishments. Mobile app has been known also to monitor health condition of the user. But this is not where the mobile app development started. Smartphone apps are one of the easiest ways to leverage technology to assess, monitor, and improve workplace safety. The current apps in the market enable workers and responsible personnel to evaluate tasks and work safely. Here are just few of the mobile apps developed in Saudi Aramco that supplements Safety or any part of its Safety Management System: SafeTravel solution is a digital journey management tool that addresses the requirements of a journey management expectations. It is designed to provide automatic notifications alerting any late check-ins or emergency alerts. It tracks drivers trips and provides positive communication. With integrated multiple systems, its capability had become stronger and more efficient. Another mobile app that was developed was SafeLife intended to ease immediate reporting of incidents, conducting safety inspections, and other functionalities. To have a more accurate and efficient way ofconducting preventive maintenance of facilities and assets, Saudi Aramco created the PM Mobility. It is a real-time maintenance management system App with features to enable the users to perform maintenance-related activities

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efficiently. The objective and value of this mobility App include but not limited to: productivity and safety improvement in the workforce, shorten maintenance work cycle, promotes360 views of operations, reduction of unplanned downtime, geo-enabled functional locations and equipment, and more.

VI. VIDEO CONFERENCING

Although video conferencing has been known to be in-use for several years, the utilization of different video conferencing platforms had increased during the pandemic of COVID-19. Platforms like Skype for Business, Microsoft Teams, Google Meet, Zoom, and several other software had an enormous increase of usage. For instance, Zoom had 10 million daily meeting participants in December 2019 and by April of 2020, the number had increased to over 300 million. Google Meet and other providers experienced the same with hundreds of millions of users. Furthermore, it is likely that the use of video conferencing will continue long after the pandemic ends, as Gartner predicts that only 25% of business meetings will take place in-person by 2024.[11]For Saudi Aramco where not all operational activities can be done remotelybut had to fully impose all precautionary measures for the health and safety of its most valuable asset, their employees, it had to evaluate operational work activitiesto have them accomplished while working at home. Saudi Aramco experts worked on enhancing capabilities of its video conferencing and even ensuring vast security measures. With its advanced infrastructure including 5G network and fiber optic (FO) connectivity, the issues in video conferencing connectivity were addressed and resolved giving its users a better experience.

VII. ARTIFICIAL INTELLIGENCE (AI)

Artificial Intelligence is now being utilized in Health and Safety as a proactive tool in predictive analysis. One of the most useful functions of AI is the ability to analyze very large amounts of data in an instant, providing factual evidence from calculations and analysis that would take humans many hours or days to compute. The use of AI to understand and analyze trends will become even more valuable. AI can also be used to manage safety programs, ensuring that everyone gets the right information when they need it. When applied properly, AI can help workers respond to hazards more efficiently by predicting trends and recognizing warning signs. Artificial Intelligence provides early warning when a hazard or unsafe practicesare recognized or identified in the workplace. Hazards that sometimes are not spotted by the human eye. Even safety training can benefit from AI. Analyzing training gaps across entire organizations can help identify deficiencies and help ensure training is being delivered to the right people at the right time. When AI is integrated into programs or other IT solutions, it can provide significant change and improvement that benefits companies, workers, and even assets.

VIII. LOCATION DEVICES, SENSORS & RFIDS

These devices are helpful in different industries including construction. Construction sites can sometimes become complex due to movement of heavy equipment, workers, and the existing condition of the surrounding like excavations. When location devices, sensors, and RFIDs are put together and programmed in a way that provides early warning detection, tracking and monitoring, it basically becomes proactive tools that prevent occurrence of incidents. Often, these devices are installed in worker's clothing or PPEs. One example of sensors and RFIDs utilized in Saudi Aramco are the Heavy Equipment Proximity Sensors and Worker's RFID Tags. These sensors along with its camera are installed in heavy equipment that detects any workers wearing RFID tags who are in close proximity. This sends audible and visual alarm to the operators triggering the operation of heavy equipment. Another example is an environmental sensor that is embedded into clothing and can detect heat, chemicals and monitor gasses with UV. This will help monitor the worker's physical health and safety when they are working in hazardous conditions. In Saudi Arabia, outside temperature can increase up to 50°C. In such environment, monitoring worker's physical health condition is very critical to prevent any heat-related illnesses. Cold Wear/Vests are made of sensors that monitor the user's body temperature, perspiration, and humidity levels when employees are working outside in extreme weather conditions. The information is sent to check the staffs' physical condition and safety. For example, if an employee is experiencing dangerously high or low body temperatures they can be called to leave the site immediately to seek medical attention.

IX. SMART PPE

Implementing smart personal protective equipment (PPE) helps prevent workplace injuries, reduce costs and improve productivity. It can be in any form of personal protective equipment that's connected to the internet and can deliver real-time safety information. It aims to reduce personnel exposure to risk through the data collected that is used to send notifications to adjust internal and external conditions. The real-time effectiveness of smart PPE reporting means that the responsible person can detect exactly when a worker trips, falls, loses their balance, or carries too much weight.

Smart Glasses allow two-way communication between the workers and their coordinators or Supervisor. Also, it can send important information such as video and audio recordings to help them stay safe while working on the site.

Smart Helmets help protect workers by having a range of sensors that check the temperature, oxygen levels in the blood, brain activity, and the heart rate of the user. The data is tracked and stored in real-time, providing management with key information to make them aware of instances where an employee may be too tired or not focused enough to perform tasks safely. It can also allow users to access vital data through their visor. Making it safer for employees

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to carry out other manual tasks with their hands-free, rather than struggling to balance holding onto clipboards or tablets.

X. CONCLUSION

Technology indeed offers a spectacular improvement in day-by-day operations. The overall result based on many studies has seen an increase in efficiency, and communication, especially the swift access to critical information which has made decision-making much easier and more accurate. From a safety viewpoint, the current amazing technologies will lead to improvements in overall human health and safety.

Having all these IT solutions and continuously evolving technologies, it proves that automation of HSE processes and integration with selected and properly evaluated IT systems and/ordigital technologies enhances company safety performance, increases organizational efficiency, and prevents or reduce accidents which could cause injuries, loss of life, and damage to property.Similar to the importance of IT infrastructures, it is worth to mention that cybersecurity plays significant role in successful and secured implementation of these advanced technologies.

Saudi Aramco's commitment in further enhancing the health and safety of its workforce and facilities through application of several digital technologies is a driver to a more productive and efficient world leading Oil and Gas company.

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