CMO LABS
**Innovation Research
for a Safer Future**

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Welcome

Dear EHS Professional,

At CMO Software we have been helping companies build safer, better-regulated working environments for many years. We are constantly developing our software to make it easier to manage environmental, health and safety (EHS) risks and to stay ahead of complex organizational, regulatory and audit compliance requirements. In addition, we are constantly researching new technologies that could potentially be integrated to further enhance its capabilities and help EHS professionals be more efficient in making their work places safer.

In this guide, I outline three key areas that we are currently researching along with detailed descriptions of the benefits to health and safety processes we believe they will bring. In summary, these areas are:

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1 **Wearable Technologies** such as smart watches and skin patches to provide real-time health monitoring of employees working in dangerous places, and helmets and smart glasses, which assist safer working for employees performing complex tasks in hazardous environments.

2 **Unmanned Aircraft Vehicles (UAVs) and Drones** that help health and safety inspectors perform audits in difficult-to-reach or dangerous locations without exposing themselves to unnecessary risk.

3 **Business Intelligence** to help EHS professionals predict and prevent incidents by analyzing the large amount of data that is available to them in their EHS Management Systems.

At **CMO Labs**, we are excited to be researching new technologies that will contribute to making EHS Professionals more efficient leading to safer working environments for all. If you would like to learn more about our research or would like to be considered for future research projects then please get in touch with your local **CMO Software** office.

Best regards,

J.C. Novoa
Chief Technology Officer

Join our Research Programs

We are always looking for research partners who are interested in working with us to help us understand how new technologies could redefine the future of health and safety in the workplace. Please contact us if you are interested in being considered for one of our beta programs.

Become a Technology Partner

At **CMO Labs**, we are constantly evaluating new technologies that could be integrated into our best practices to help EHS professionals continue to create safer working environments. If you believe you have a product or technology that could be of interest, please contact us to be considered for inclusion in one of our future research programs.

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Wearable Technologies

Employees in industries such as oil and gas, mining and construction frequently have to work in dangerous locations to perform their roles. While companies do everything they can to reduce the risks associated with these work environments, there is still a chance that something could go wrong leading to an emergency that needs to be resolved quickly.

The decrease in both the cost and size of sensors used to measure vital signs and environmental parameters means that wearable technology such as smartwatches and skin patches are now a practical and viable way of monitoring the well-being of employees when they are working in dangerous locations. If for example, there is a sudden change to the wearer's heart rate or other vital signs, action can be taken to determine why they are suddenly under increased stress and emergency action can be taken if necessary.

Vital signs and other key statistics that could be monitored by wearable devices include:

- Heart rate
- Temperature
- Respiration
- Perspiration
- Dehydration
- Blood oxygen levels
- GPS location
- Distance walked
- Ambient noise levels
- Proximity to a particular hazard

If these vital signs were to be transmitted back to a central location, a health and safety manager would be able to assess the stress and danger levels that the worker is experiencing in real-time. This would increase the likelihood of swift action being taken in the event of an emergency. For example, this action could include monitoring the worker using CCTV or a UAV, shutting down machinery or sending help to the scene.

In addition to monitoring vital signs and environmental parameters, we see an increase in health and safety wearable technology to provide hands-free, heads-up displays for workers performing complicated procedures in dangerous environments. These headsets, helmets and goggles provide:

- **Text and graphical displays** replacing paper or laptop-based manuals to guide the wearer on how to perform complex operations
- **Video transmission** from the workplace to a centralized location so that informed decisions can be made away from the stresses of the dangerous situation being experienced
- **Communication with the operator** to relay real-time instructions, alerts, and warnings about the situation they are experiencing

At **CMO Labs**, we are evaluating the different types of wearable technologies available and are researching how they can be effectively included into EHS best practices to make dangerous working environments safer for workers.

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Wearable Technologies – User Scenarios

NOTIFICATION OF DANGEROUS ACTIVITIES

Health and safety managers need to know when employees are performing dangerous activities such as working in confined spaces or at height. When using wearable technology such as a smart watch, workers could simply tap a button on an app integrated with a central system to inform others that they are about to start a dangerous activity. The app could then start a countdown timer to ensure that the employee does not spend more than the permitted time performing the dangerous activity. If the time is exceeded then an alert can be sent to inform others that there may be an issue.

VITAL SIGNS MONITORING AND EMERGENCY RESPONSE

In addition to ensuring that a worker does not exceed the maximum permitted time performing a potentially dangerous activity, wearable technology such as smartwatches could be used to monitor their stress levels. For example, if their heart rate suddenly starts increasing this would indicate that they are experiencing a stressful situation. In addition to changes in vital signs triggering an alert, the wearable device could act as an SOS button, which would allow the wearer to send an alert manually. Alerts containing information about the exact location of the worker would be sent to a supervisor at a centralized monitoring station and would be used to establish the potential causes of the emergency based on the hazards identified for that location and whether others in the area could be affected. Using this information, the supervisor could implement an emergency response procedure such as remotely shutting down

dangerous equipment or using the location information of others to determine if they are close enough to provide assistance.

PROACTIVE NOTIFICATIONS

If an EHS or site manager determines that there is an impending hazard to the oilrig, mine, construction site or other potentially dangerous workplace, they need to inform all workers within the danger zone as quickly as possible. If all users have smart wearable technology then the manager can first of all quickly determine those that are within the critical zone using location-based services. Those workers can then be sent specific instructions regarding stopping activities, evacuating threatened areas or other information required to prevent an accident from occurring.

As well as notifications of potential danger, EHS managers can issue proactive instructions to prevent potential accidents from happening due to known hazards. For example, if heavy objects are to be moved over a particular area on a construction site, the workers in that area could be alerted via their wearable devices so that they can move clear of potential drop zones.

ENVIRONMENTAL MONITORING

Workers in the oil and gas industry do not always have the latest, easy-to-use technologies to help them do their jobs as efficiently and effectively as possible. For example, they typically carry gas-monitoring equipment and are required to communicate alerts via their radio in the event of a leak being detected.

Wearable smart sensors would significantly improve employees' safety as alerts could be automatically passed back to their safety manager in the event of gas being detected in the atmosphere.

TECHNOLOGY ASSISTED WORKING

As well as sensors to detect and alert about potential dangers, the development of smart headsets and glasses is a potentially interesting wearable technology area, which could significantly improve the health and safety of workers.

Field engineers frequently have to refer to instruction manuals and safety guidelines when performing complex and potentially dangerous tasks to ensure that they do not miss out any steps and execute them in order. Relying on paper-based or even laptop-based instructions means that they have to take their eye off the task in hand. Smart helmets or glasses solve this problem by providing the wearer with additional, context-sensitive information about what they are currently viewing by projecting images onto the glass. This technology not only increases the worker's safety, as they no longer need to refer to manuals, but also increases their efficiency and productivity.

In addition to augmented reality and instructions, wearable helmets and glasses could also transmit real-time video back to a central office so that other experts can see what is happening on the ground and help make informed decisions. Engineers could also collect data about potential hazards using dictation technology reducing the need for them to carry ruggedized laptops or having to input data manually when they return to the office.

Benefits of Wearables in EHS

The use of wearable technology such as smartwatches, sensor patches, smart helmets, and glasses could provide the following benefits for companies that operate in dangerous and high-risk environments:

- Real-time monitoring of the health of employees who are conducting dangerous work

- Tracking of employees so that they can be alerted if they are entering a hazardous zone or are about to be exposed to potential new hazards

- Augmented reality to assist workers performing complex and potentially dangerous tasks that may require many different steps and help from others located offsite

CMO Labs Research into Wearable Technologies

CMO Labs are investigating the feasibility and value of extending current products such as Job Hazard Analysis and Alerts and Reminders to include integration with wearable technology.

We envisage that the intelligent collecting and analysis of data from wearables in the field by a centralized platform will allow our customers to make better decisions and react quicker to potential emergencies.

Unmanned Aircraft Vehicles and Drones

Construction, mining, oil and gas and other dangerous industries all require regular inspections to meet statutory regulations and to ensure their continuous safe operation. Traditionally this means exposing employees to significant risk while they inspect difficult to reach locations and dangerous plant equipment. Even if stringent guidelines are followed, there is still a potential risk to the employees' safety.

To reduce the risks that inspectors are exposed to, the use of unmanned aircraft vehicles (UAVs) and drones to perform inspections is being considered by many companies. At **CMO Labs**, we are currently working with major UAV vendors to integrate this technology into our EHS best practices guidelines.

UAV and Drones – User Scenarios

We have identified a number of different industries and scenarios where we believe UAVs and drones can significantly help improve the health and safety of both EHS inspectors and employees working in these difficult and dangers environments. Below is a summary of the industries we are currently investigating.

OIL AND GAS

Offshore oil and gas drilling structures are prone to rust due to the extreme nature of the environments they operate in. Many rigs that were designed to last for 20 years have been in service for over 40. This means that they are highly likely to suffer from cracks, corrosion and physical damage from waves.

[1]The terms Unmanned Aircraft Vehicles (UAVs) and drones is often confused. A UAV is controlled by a pilot on the ground who may wear goggles so that he can view a live video feed transmitted from the UAV to assist with flying. Typically, a UAV will have a pilot responsible for its flying and an operator who will be responsible for controlling the camera and performing safety inspections. A drone does not have a real-time pilot but instead relies on GPS and a pre-defined route. So, for example, drones could be used to fly along a pre-defined route along a pipeline to record video or detect for gas leaks.

Operators need to regularly inspect their rigs so that they can proactively repair minor cracks and damage before they cause catastrophic failure, which could endanger employees' safety and threaten continued drilling operations.

Traditionally, safety inspections have involved workers abseiling down the side of the rig structure or climbing high-rise stacks to perform checks and manually record wear and tear. High winds and waves combined with the heights involved make manual inspections risky, time-consuming and expensive.

The use of UAVs to perform structural integrity checks significantly increases the safety of inspectors as they no longer have to abseil from high structures and expose themselves to unnecessary risk. A UAV can be used to build up a comprehensive 3D model to report on cracks and wear and tear of all visible structural parts of a rig. Companies will have greater control over the health and safety of their rigs as they can inspect difficult to reach areas to analyze the entire structure and prioritize where repair work needs to be carried out first.

Significant time and cost savings can be achieved as inspections by UAVs can be up to eight times quicker than human inspections. In addition, flare stacks can be inspected while in production eliminating the need for expensive shutdowns. As a result of the UAV inspection, the shutdown time required to perform repairs can be minimized as the necessary replacement parts and repair personnel can be acquired before work commences.

As well as managing the safety of rig installations, operators have to ensure that pipelines spanning thousands of miles are leak free. Drones fitted with gas detectors can be used to fly along pipelines to check that they are leak free. If a leak is detected, the gas can be isolated to guarantee the safety of workers when they perform repairs.

MINING

Statutory structural audits need to be performed regularly in the mining industry to ensure that new hazards have not been created as a result of vibration, stress fatigue or corrosion. These audits can take a significant amount of time and usually involve checking dangerous and difficult to access locations. Inspectors have to either put themselves in danger when entering high-risk areas or omit to inspect all areas resulting in the true condition of the work environment not being fully known. The lack of a thorough safety audit could result in the mining company not meeting statutory inspection and audit requirements and, more seriously, could endanger the lives of its workers.

The use of UAVs greatly increases an inspector's ability to perform a complete safety audit of a mine as they provide greater visibility into areas that are difficult or impossible to access. Using UAVs decreases the risk for the inspectors as they can remove themselves from most of the danger presented by the mine. They also increase the overall safety of the mine for all employees

as a more comprehensive picture of workplace hazards can be quickly and cost-effectively obtained.

If during an inspection, a potential risk is uncovered, the inspector can take detailed photographs or videos, which can be used by engineers to determine the necessary corrective action before repair work is undertaken. This means that before they visit the site, they have already been able to assess the safety requirements and can carry with them the necessary equipment to make the situation safe.

CONSTRUCTION AND CIVIL ENGINEERING

Construction companies have to ensure that workers on their sites stay safe for the entire lifecycle of a project. This means that they have to constantly monitor all areas of their construction sites to ensure that safe working practices are being implemented. Regular inspections can be expensive and incomplete if inspectors have difficulties accessing all areas of the site.

In addition to new construction projects, civil engineers have to perform regular safety checks on bridges, elevated roads, exhaust stacks, buildings and other structures. Visual inspections of high or difficult to reach places present significant challenges for inspectors and surveys using binoculars are often insufficient.

The expense of ongoing safety audits can be substantially reduced using UAVs to quickly survey large and often inaccessible construction sites. This means that checks can be performed more frequently resulting in potential hazards being spotted and mitigated before they cause major incidents. Existing structures can also be checked more frequently and safely at a much closer range that from the ground using binoculars. This means that minor defects can be detected and prevented from getting worse before they cause catastrophic failure.

In the same way as described for mining earlier, if hazards are found on a new construction site or a defect discovered in an existing structure, the inspector can use the UAV to capture detailed photos or video which can be used to determine the most appropriate procedures to reduce or eliminate them.

TRANSPORTATION

Companies involved in ensuring critical transport links are safely maintained need to monitor the entire infrastructure to resolve or mitigate against potential hazards before they cause accidents. This includes ensuring the integrity of bridges, elevated roads, tracks and other parts of their network infrastructures as well as checking the sides of roads and railways to assess the risks from rock falls, trees, and other potential obstacles.

Drones allow those responsible for transportation safety to monitor large

stretches of their network quickly and cost-effectively so that accidents can be prevented. If any potential hazards are discovered, detailed photographs and videos can be uploaded to a central EHS system and the appropriate actions assigned to mitigate them quickly.

Benefits of UAVs and Drones in EHS

From the research topic summaries above, you can see that there are a number of different areas where UAVs and drones can help increase safety. We are focusing on the following scenarios:

■ **Safer Inspections**
By deploying UAVs and drones to carry out safety audits, health and safety inspectors can perform their duties without exposing themselves to workplace hazards. This means that checks can be performed more quickly and more cost-effectively because they do not have to use ropes, rigging, and other safety devices. It also means they can be more thorough as they can access difficult-to-reach locations.

■ **Safer and More Effective Repairs**
As a result of using UAVs and drones to take photographs or to shoot video footage of a hazard or infrastructure failure, engineers can fully plan the work that needs to be carried out before they visit the site in question. This means that any safety considerations can be planned for ahead of time and the necessary tools and spare parts taken on site.

■ **Safer Workforce**

Comprehensive and more frequent safety inspections as well as quicker and more efficient hazard removal and repairs, facilitated by UAVs and drones, mean that the workplace not only meets regulatory requirements but is also safer during its continuous operation.

The use of UAVs and drones can result in the following benefits for companies that operate in dangerous and high-risk environments:

■ **Increased safety and reduced risk for inspection personnel**

– UAV-based inspections eliminating the need for inspectors to access dangerous areas using rigging, harnesses and scaffolding to perform inspections of plant equipment

– Inspections of high structures of up to 400 feet (122 meters) can be carried out using UAVs to eliminate the need for workers to climb to potentially dangerous heights.

■ **Time savings**

– Inspections can be performed quickly as there is no need to set up rigging, scaffolding, or other safety measures

– Overall safety audits can be reduced to one day instead of taking a week or more when performed manually

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– Repairs and general maintenance can be managed proactively as high-resolution photographs, videos, and thermal images can be uploaded to the company EHS Management System providing additional detailed information for the repair and maintenance task requests

– Safety managers can gain insight into potential emergencies quickly as UAVs can be deployed to virtually any part of an oilrig, construction site or any other hazardous location without the need for addition time to set up personnel safety equipment.

■ **Cost savings**
– UAV inspections significantly reduce the need for plant downtime to perform critical inspections.

– Shutdown times for maintenance can be reduced due to better planning as a result of UAVs being used to intelligently document findings using photographs and video

– Fewer people need to be involved in safety audits reducing costs and risk.

CMO Labs Research into UAVs

There are many different options for companies wanting to use UAVs and drones to decrease the risks associated with their safety inspections. At **CMO Labs**, we are researching how these technologies should be integrated into an overall EHS best practices framework to maximize their potential to improve the overall quality of inspections.
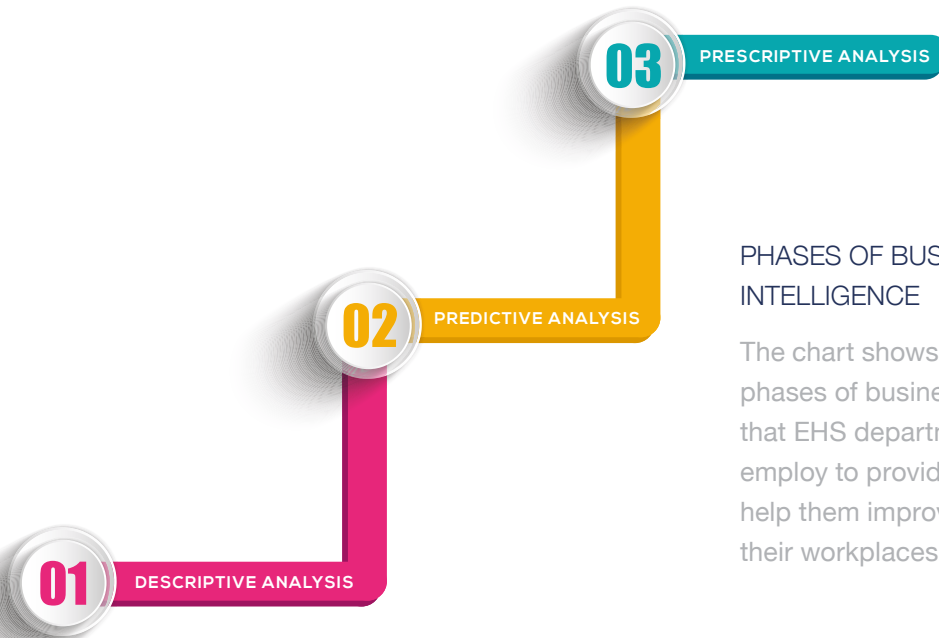
Business Intelligence

Large companies use business intelligence to help with activities such as identifying patterns in customer buying behavior, predicting future stock requirements and detecting fraud. To do this, they collect large volumes of transactional data and apply sophisticated statistical algorithms to find patterns. All of this has been made possible due to process automation making more data available and the continual decrease in the cost of computing power.

Hazardous industries such as oil and gas, chemicals, transportation, and construction all have a wide variety of regulations with which they have to comply. In order to do this, they need to measure and record significant amounts of data to prove their compliance to governing authorities. This information includes:

- Incidents
- Near misses
- Root cause analysis investigations

- Spillages of toxic substances
- Absence due to health and safety accidents
- Fines and compensation claims

Traditionally, this information has been stored purely for compliance reasons and has mainly been used in isolation to tactically improve business operations. However, by using business intelligence techniques, it could be possible to significantly reduce environmental, health and safety incidents and help companies move towards operational excellence. This will bring greater value to the enterprise over and above just meeting compliance requirements.

03 PRESCRIPTIVE ANALYSIS

02 PREDICTIVE ANALYSIS

01 DESCRIPTIVE ANALYSIS

PHASES OF BUSINESS INTELLIGENCE

The chart shows the three different phases of business intelligence that EHS departments could employ to provide intelligence to help them improve the safety in their workplaces.

Descriptive Analysis

Traditionally, EHS professionals have used statistical methods on historical data to determine what happened and why. This gives them a good indication of past performance such as how many incidents of each type have occurred and allows them to establish what has caused them. Using this information, an organization can learn form previous mistakes and put controls in place to mitigate risks and eliminate or reduce hazards.

Predictive Analysis

More mature organizations will apply rules to their historical health and safety data, which may be combined with external data, to predict incidents that may happen in the future along with their probabilities. When implemented properly with employees being able and willing to report near misses and incidents, this is a good method of predicting certain types of incident.

Clearly, this is a step beyond descriptive analysis as in increases the likelihood of preventing an incident from occurring. However, in order to actually prevent the incidents from happening, EHS professionals have to analyze the results of the predictive analysis and determine the correct courses of action that need to be taken.

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Prescriptive Analysis

In order to fully benefit from business intelligence predictions, EHS systems should ideally go one step further than just forecasting what could occur by suggesting actions that should be taken along with any associated consequences of each option given. This would help the organization make decisions around maximizing future opportunities or the best chance of mitigating any risks they are faced with.

Benefits of Business Intelligence in EHS

At **CMO Labs**, we see advanced business intelligence providing many potential benefits to health and safety. These include:

- **More reliable hazard detection processes** – Rather than relying solely on human expertise, computer-based algorithms can be used to detect issues resulting in potential improvements in accuracy.
- **Reliable sharing of best practices** – Best practices in risk detection can be codified into computer algorithms and easily shared across multiple geographies and divisions. This results in greater consistency across the company, as employees do not have to be relied on to share best practices anecdotally.

These all result in an increase in the detection of risks that will lead to a decrease in the number of serious accidents.

EHS business intelligence should involve sifting the huge amount of health and safety data that is collected by the organization, finding the relevant information, and turning it into prescriptive actions that will lead to a safer and more compliant working environment.

CMO Labs Research Into Business Intelligence

CMO Labs are currently investigating the feasibility of using machine-learning technologies to help organizations not only predict the probability of incidents but to also suggest actions to benefit from them.

About CMO Software

We help companies build safer, better-regulated working environments with EHS & GRC applications that are easy to deploy, adapt and use.

Our software solutions make it easy to manage environmental, health & safety risks and to stay ahead of complex organizational, regulatory and audit compliance requirements.

We've made our multi-lingual applications simple, intuitive and accessible anywhere – so employees will want to use them, no matter where they are.

For additional information visit
www.cmo-software.com

Simple. Intuitive. Site-Ready.

Build a safer, better-regulated working environment with EHS & GRC applications that are easy to deploy, adapt and use

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