A Marketing Plan for an Alternative Method of Workplace Safety in the U.S Construction, Transportation, and Mining Industries Based on Real-time Impairment Detection

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Executive Summary

Companies in the mining, transportation, and construction industry have been trying to create safer workplaces for their employees. These industries involve the use of heavy equipment and vehicles. Due to the very nature of the industry, this can lead to dangerous conditions for employees. Established workplace safety solutions are based on drug testing and compliance activities in support of existing regulations and requirements. There are also a number of existing barriers to the use of nontraditional methods such as real-time impairment monitoring. With modern technology, detecting real-time impairment is possible. The use of these non-intrusive solutions can prevent workplace accidents.

The first report's objective was to analyze and understand the selected targeted industries of construction, mining, and transportation in the United States. Then followed by understanding the accidents that occur in each industry and how different organizations work towards creating a safer workplace environment. Current practices include drug testing employees, creating workplace safety plans and the implementation of programs resulting from governmental laws and regulations for a safer workplace. Implementing new technologies and techniques for workplace safety comes with different challenges, including privacy concerns, legal barriers, regulatory barriers, and existing industry practices.

Our second objective was to investigate different impairment detection devices that are currently being developed. Impairment monitoring is a critical emerging practice for workplace safety that involves monitoring employees for signs of impairment that may affect their ability to safely perform their job duties. This practice can help to identify potential problems early on, such as substance abuse or disabilities, and take steps to address them before they become serious safety hazards. By implementing an effective impairment monitoring program, employers can promote a culture of safety in the workplace, reduce the risk of accidents and injuries, increase productivity, and improve the well-being of their employees.

There multiple devices that are currently emerging such as Sobereye, Vigo, WHOOP, and LifeBand. These are just some examples of the many IDTs that exist. These are different types of technologies such as wearable headsets, wearable headbands, devices similar to a watches and visors. All of these different technologies detect if an individual is impaired or not in a matter of seconds or minutes. These devices effectively create a safer workplace, but they are difficult to implement due to companies being comfortable with current practices such as drug testing as well as unions not wanting their members to be tested coupled with

the current laws that exist about workplace safety. Additionally, the lack of knowledge about IDTs further increases the difficulty of their implementation in the workplace. This has made the promotion of those devices difficult which leads us to our marketing strategy.

Our last objective was to find a way for these developers to market their product, due to the fact that IDTs have not been implemented in many organizations. There are multiple ways that organizations can promote their devices and also teach workers and employers about IDTs. Some of the marketing tactics that developers can use are: Partnering with distributors to reach a wider market share, collaborating with unions and collaborating with regulatory organizatinos to teach them about their device and IDTs, market their product as a cost saving solution and lastly creating an online marketing network to have a wider reach of their customers. By implementing these different marketing tactics, IDT developers will be able to improve their reach to many groups of people and increase the amount of customers they are working with. By doing this, workplaces in the different industries will become safer and more effective for all.

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1. Introduction

1.1 - Overview of Workplace Safety

The transportation, mining, and construction industries are essential to the growth and development of the US economy. These industries employ millions of workers and generate trillions of dollars in annual revenue. However, the nature of these industries often exposes employees to unique and significant health and safety hazards. From operating heavy machinery in construction to underground mining and navigating busy roads as truck drivers, workers in these sectors face a range of risks that require a focus on the job to be done to ensure their safety. The Occupational Safety and Health Administration (OSHA) is responsible for establishing and enforcing standards that protect workers in these industries, but it is ultimately the responsibility of employers and workers to work together to create safe and healthy working environments.

Prior to the COVID-19 pandemic, workplace safety practices largely relied on traditional methods such as personal protective equipment (PPE), regular safety training, safety program audits, and accepted safety measures. These industries have a high rate of workplace accidents and injuries due to the physically demanding and hazardous nature of the work.

The transportation industry has been implementing safety practices for many years to reduce accidents and injuries in the workplace. One such practice is using seatbelts and airbags in vehicles, mandatory drug and alcohol testing, and regular vehicle maintenance. In addition, the Federal Motor Carrier Safety Administration (FMCSA) has established safety regulations for commercial drivers, including hours of service limits, maintenance requirements, and safety training programs.

In the construction industry, there is a high rate of workplace accidents, particularly falls and electrical hazards. In an effort to reduce these accidents, OSHA has established several safety standards, including fall protection requirements, electrical safety regulations, and safety training programs. In addition, many construction companies have implemented regular safety inspections, job hazard analysis, and the use of PPE such as hard hats, safety glasses, and gloves.

The mining industry is one of the most dangerous industries, with a high rate of accidents and injuries. The Mine Safety and Health Administration (MSHA) has established regulations, including ventilation requirements, dust control measures, and regular safety inspections. Mining companies have implemented safety training programs, including the use

of PPE such as protective helmets and respirators, and safety technologies such as proximity detection systems.

1.1.1 Current Methods and Techniques Used for Workplace Safety

The COVID-19 pandemic has increased awareness and attention to workplace safety and many organizations are taking a more proactive approach to protecting the health and safety of their employees. Overall, the current view of workplace safety is one of constant vigilance and adaptation in order to protect workers from potential hazards.

Ensuring workplace safety is critical in the mining, transportation, and construction industries. The nature of work in these industries often involves significant physical hazards, such as falling objects, exposure to toxic substances, and the operation of heavy machinery. As such, it is essential to employ various methods and techniques to reduce the risk of accidents and injuries.

One of the most fundamental approaches to ensuring workplace safety is the use of PPE. PPE, including hard hats, safety glasses, and steel-toed boots, are commonly used in mining, transportation, and construction industries to protect workers from physical hazards. According to data from the Bureau of Labor Statistics (BLS), the use of PPE has significantly reduced the number of injuries in the construction industry. In 2019, the BLS reported that the use of PPE reduced the number of injuries by 66% in the construction industry alone (Bureau of Labor Statistics, 2020). Another method used to improve workplace safety is automation. Automation is increasingly prevalent in mining, transportation, and construction industries and has the potential to reduce workplace injuries. For instance, the use of automated drilling machines in the mining industry has reduced the number of accidents caused by drilling-related tasks (International Mining, 2020). Adequate safety training is another critical method employed to prevent accidents in the mining, transportation, and construction industries. Training workers on identifying hazards and teaching them how to operate machinery and equipment safely is essential in reducing accidents. In a study conducted by OSHA, effective safety training was shown to reduce injury and illness rates by 60% (Occupational Safety and Health Administration, n.d.). Safety culture is also vital to reducing workplace accidents. A safety culture is one that promotes safety as a core value in the workplace. A study conducted by the National Institute for Occupational Safety and Health (NIOSH) found that safety culture was associated with lower injury rates in the construction industry (National Institute for Occupational Safety and Health, 2016). Building a safety culture in the workplace is critical to reducing the risk of accidents and ensuring that

safety remains a priority. Finally, ergonomic interventions, such as the use of ergonomic tools and the redesign of workstations, can significantly reduce the risk of musculoskeletal disorders in the mining, transportation, and construction industries. Musculoskeletal disorders account for a significant portion of all workplace injuries in the construction industry, according to the BLS (Bureau of Labor Statistics, 2020). PPE, automation, safety training, safety culture, and ergonomic interventions are essential methods used to improve current workplace safety.

Figure 1.1.1: *Examples of common PPEs that currently exist (SafetyCulture, 2018).*

1.1.2 Training

Training is critical for workplace safety. According to OSHA, workers in the construction industry receive both on-the-job and classroom training, covering safety regulations, proper equipment usage, and emergency procedures. Workers are also required to pass certification exams. In the mining industry, workers receive both surface and underground training, covering safety regulations, proper equipment usage, and emergency procedures for subterranean environments. In the transportation industry, workers receive both classroom and on-the-road training, covering safety regulations, proper equipment usage, cargo transportation, and compliance with federal regulations. A study by NIOSH found that effective training programs can reduce the risk of accidents and injuries by up to 40% in these industries.

1.1.3 Safety Equipment

Safety equipment is an essential component of any industry that exposes workers to dangerous conditions. There are multiple organizations that create policies for what type of safety equipment is required in each industry or organization. OSHA is responsible for setting standards and providing guidance on the appropriate safety equipment that should be used in the workplace. This includes providing regulations on the use of PPE, such as hard hats, safety glasses, and gloves. In a study conducted by OSHA, it was estimated that the use of PPE can reduce the number of lost workdays due to injury by as much as 50% (OSHA, 2022). It also sets standards for the use of fire extinguishers and emergency exits, as well as specific requirements for hazardous materials. The National Fire Protection Association (NFPA) provides standards for the use of fire safety equipment in the workplace.

It is important to understand that not all industries require the same safety equipment. Each one has different potential risks that need different types of safety equipment. An example would be the safety equipment used in the mining industry, where a lot of problems exist with air quality and the need for ventilation and breathing devices is crucial. Furthermore, the use of ventilation and breathing devices in the mining industry has been proven to improve air quality and reduce the risk of lung-related illnesses among miners (NIOSH, 2020).

1.1.4 Drug Testing

Drug testing is used in most industries in the United States. The idea for using drug testing is to improve the performance of workers and also avoid accidents in industries that require physical labor. Methods include random drug testing, random suspicion testing, post-accident drug testing, and pre-employment drug testing. This might be an effective way to identify workers that use substances, but not necessarily a good way of identifying if a worker is impaired. Organizations implement different types of drug testing such as urine tests, oral testing via mouth swabs, hair follicle testing, or breathalyzers. Drug testing tells an organization if any worker is consuming drugs, which might affect their performance.

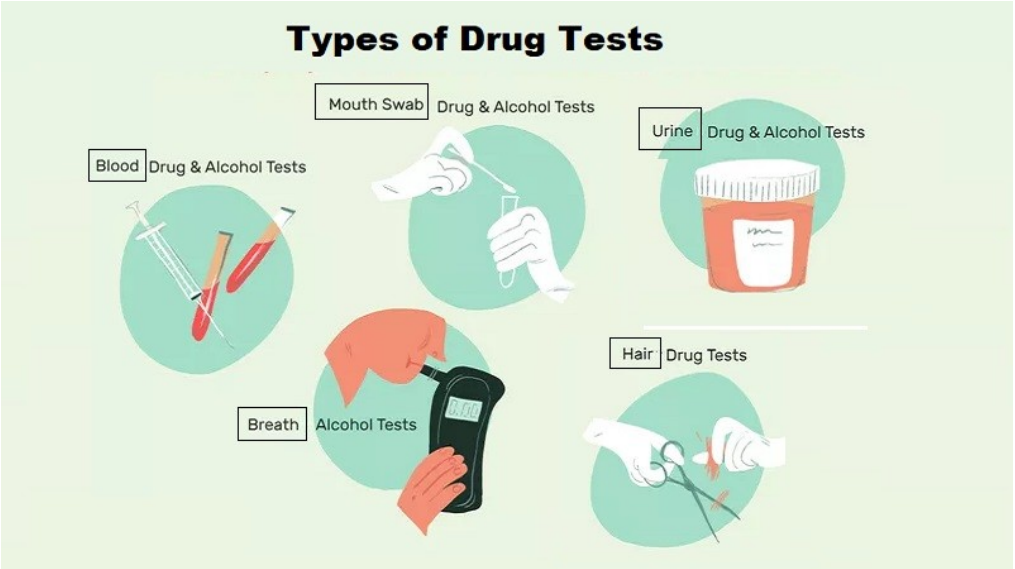

Figure 1.1.4: *Different types of drug testing methods (Helalmedical, 2022).*

Privacy is a concerning factor when using drug testing. Drug testing has been flagged by employees as a violation of their right to privacy outside the workplace. There are many reasons why drug testing is not as effective as one would think. Drug testing in the workplace can lead to a positive test for employees that use drugs/alcohol during their private time outside of the workplace, despite the fact that they are not impaired while at work. It can also affect the productivity/motivation of an employee to be tested for drugs, even when that person does not use any, just because of the process, they might feel undermined or not trusted.

1.1.5 Fatigue Testing

Fatigue testing is being used as an important component of workplace safety in many industries that often involve long hours and demanding physical labor, which can lead to fatigue and an increased risk of accidents and injuries. Fatigue testing allows companies to measure the level of fatigue in their workers, and to take steps to address any issues that may arise. In the construction industry, fatigue testing is typically implemented by monitoring the workers' sleep patterns, as well as their physical and cognitive performance. This can be accomplished using wearable devices such as sleep trackers, or through self-reported questionnaires. In addition, companies may use visual and auditory tests to evaluate the worker's reaction time and attention span.

The mining industry uses similar methods to monitor fatigue, including physiological measures such as heart rate variability, and skin conductance to evaluate the worker's level of

stress. The mining industry is known to have long working hours and harsh conditions, which can exacerbate the problem of fatigue. In the transportation industry, fatigue monitoring is implemented by monitoring the driver's hours of service and rest, as well as their physical and cognitive performance. Federal regulations require trucking companies to keep records of their drivers' hours of service and to ensure that their drivers are getting the necessary rest. Fatigue testing in the transportation industry can also include monitoring the driver's eye movements, and reaction time to evaluate the driver's level of fatigue.

1.1.6 Observational and Self-Reporting Fatigue Monitoring

Observational and self-reporting are two common methods for monitoring fatigue. Observational fatigue monitoring is a method of assessing an individual's level of fatigue based on observable physical and behavioral signs. This type of monitoring can be useful in a variety of settings where fatigue can impact safety, productivity, and overall health and well-being. Some of the physical signs that can be observed in individuals who are experiencing fatigue include droopy eyelids, slurred speech, decreased physical activity, and changes in posture. Behavioral signs of fatigue can include irritability, forgetfulness, and decreased concentration. These signs can be used to create a fatigue score that reflects the severity of an individual's fatigue.

Observational fatigue monitoring can be conducted by observers who are trained to recognize and accurately record the signs of fatigue. In some cases, technology such as wearable devices or computer programs can be used to assist with the observation process. One of the benefits of observational fatigue monitoring is that it provides objective information about an individual's level of fatigue. This information can be used to identify patterns and trends in fatigue, which can help to determine the root cause of fatigue and guide appropriate interventions.

Self-reporting fatigue monitoring, on the other hand, involves asking individuals to report their own levels of fatigue. This can be done through surveys, questionnaires, or self-assessment tools. Self-reported fatigue can provide valuable subjective information about the individual's experience of fatigue. One of the benefits of self-reported fatigue monitoring is that it provides valuable subjective information about an individual's experience of fatigue. This information can be used to better understand the individual's perspective on their fatigue and can help to guide appropriate interventions.

Both observational and self-reporting methods have their own strengths and weaknesses. Observational methods provide objective information about fatigue, but they can

be subject to observer bias and may not accurately reflect an individual's subjective experience. Self-reported methods, on the other hand, are subjective and may be influenced by an individual's mood, memory, or perception of their own fatigue.

In general, a combination of observational and self-reporting methods is considered the best approach for monitoring fatigue. This allows for a more comprehensive understanding of an individual's experience of fatigue and can provide a clearer picture of the factors that contribute to it.

1.1.7 Behavior Monitoring

One of the key benefits of behavior monitoring with impairment monitoring devices is that they provide an objective measure of impairment. Unlike traditional methods of detecting impairment, such as observation or self-reporting, these devices use scientific methods to detect impairment and provide accurate results. Additionally, these devices can be used in real-time, which allows for immediate intervention when an individual is detected to be impaired.

The goal of behavior monitoring with impairment monitoring devices is to improve safety and productivity by identifying individuals who may be impaired, whether it be due to alcohol, drugs, or other factors.

1.1.8 Impairment Monitoring

Recently, impairment monitoring is being considered a viable solution for workplace safety. This involves using technology to monitor an employee's cognitive and physical capabilities in real-time. The aim of impairment monitoring is to detect issues and address any signs of impairment, including fatigue, drug or alcohol use, or other causes that could negatively impact workplace safety. Studies have shown that impairment monitoring can significantly reduce the risk of workplace accidents and injuries.

A study published in the Journal of Safety Research found that the use of wearable devices in the transportation industry led to a 28% reduction in accidents and a 40% reduction in injury rates. Workplace safety practices have evolved to address new challenges posed by the COVID-19 pandemic, and impairment monitoring is playing an increasingly important role in ensuring the safety and well-being of employees.

There are a number of technologies being used for impairment monitoring. These include wearable devices and sensors, breathalyzers for alcohol testing, and fatigue monitoring systems that use sensors to measure eye movement, facial expressions, and other

biometric data to determine a worker's level of alertness. These technologies have been shown to be highly effective in detecting and addressing any signs of fatigue, drug or alcohol use, or other impairments that could negatively impact workplace safety. In the transportation industry, for example, the use of these technologies has led to improved driver performance, reduced incidents of drowsy driving, and fewer accidents and injuries. In the construction and mining industries, impairment monitoring has helped to ensure that workers are fit for duty, reducing the risk of workplace accidents and injuries, and improving overall safety on the job.

Examples include breathalyzers and drug testing kits. According to the FMCSA, pre-employment and random drug testing is mandatory for all commercial drivers in the transportation industry. MSHA also requires drug and alcohol testing for all miners, with the purpose of promoting a safe and healthy work environment. Similarly, the construction industry has implemented drug testing policies, with a study finding that over 60% of construction companies conduct drug testing for new hires (National Institute on Drug Abuse, 2019). The use of breathalyzers, in particular, has been shown to effectively reduce the incidence of workplace accidents in the transportation and construction industries (National Safety Council, 2018). Safety equipment, on the other hand, is used to protect individuals from physical hazards such as falls, electrocution, and chemical exposure. Safety equipment includes hard hats, safety goggles, fall protection equipment, respirators, and protective clothing. This type of equipment is often mandatory in many workplaces and is used to keep workers safe from accidents and injuries. The proper use and maintenance of this equipment are crucial to ensure effectiveness in protecting individuals.

1.2 Safety Data

Impairment of any cause is a key contributing element in workplace accidents and injuries. Impairment can occur when an employee is not getting enough sleep is working too long or is under the influence, which in turn leads to decreased alertness, slower reaction times, and poor decision-making. Impairment can increase the risk of accidents such as slips, trips, and falls, motor vehicle accidents, machine-related accidents, errors in judgment, injuries from heavy machinery, fire and explosion, and chemical spills. One common type of impairment known as fatigue can even lead to chronic health issues such as heart disease, high blood pressure, and diabetes. The causes of fatigue and impairment can vary but can include long working hours, working multiple shifts, insufficient sleep, stress, social and lifestyle factors, medications, and alcohol and drug use. Employers can take steps to prevent

such accidents by implementing policies to promote healthy sleep habits and discourage drug and alcohol use. This can include providing education and training on all these dangers, encouraging employees to get enough sleep, and establishing a workplace culture that promotes healthy behaviors and safety practices.

Impaired driving is a major cause of accidents on the road, leading to injuries and fatalities. According to the National Highway Traffic Safety Administration (NHTSA), in 2019, there were 10,142 deaths in motor vehicle crashes involving alcohol-impaired drivers. These deaths accounted for 29% of all motor vehicle traffic fatalities in the United States. The NHTSA also reported that in 2019, there were 4,142 deaths in crashes involving a driver with a blood alcohol concentration (BAC) of 0.08 or higher and that drivers with a BAC of 0.08 or higher were more likely to be involved in fatal crashes.

In addition to alcohol-impaired driving, fatigue, which can lead to drowsiness, is also a major cause of accidents on the road. According to the National Sleep Foundation, drowsy driving is a factor in about 100,000 crashes each year. The National Center for Biotechnology Information (NCBI) reported that drowsy driving can cause impairment in cognitive and motor skills, similar to those caused by alcohol and drugs. Drowsy driving can lead to slower reaction times, difficulty staying in the lane, and falling asleep at the wheel.

1.3 Drug Use

Drug use in the United States is a sensitive topic. Legal and illegal drug use in the United States has been on the rise for many years. There are many factors why drug use is on the rise but it does not appear to be related to youth or poverty. In fact, individuals of all ages and economic statuses are using drugs. Apart from that, drug use is slowly becoming more accepted in society, which is a reason why the use of drugs is being normalized in society. This includes legal drugs, alcohol, and in some states, marijuana. There are also illegal drugs such as cocaine, opioids, and heroin. “The annual economic impact of substance misuse is estimated to be $249 billion for alcohol misuse and $193 billion for illicit drug use” (HHS, 2022). This includes costs due to lost work, health care, and drug-related crimes. The individuals that consume these drugs work daily, and their performances when working might be affected.

1.3.1 Legal Drugs

Alcohol, legal cannabis, and prescription drugs are all examples of legal drugs. These types of drugs are known for their effect on an individual's awareness and reaction time. Due

to these types of effects, many individuals end up causing accidents that put their own and other people's lives in danger.

In the United States, 138.5 million Americans who are 12 and over drink alcohol, and 28.3 million, or 20.4% have an alcohol use disorder. In 2018, 2.1% or 5.7 million people in the US reported misuse of prescription tranquilizers, and 0.4% or 1 million people in the US reported misuse of prescription sedatives (NCDAS, 2023). "52 million or 18.4% of Americans over the age of 12 have deliberately misused prescription drugs at least once in their lifetime" (NCDAS, 2023). 43.3% of these abusers used painkillers while 32.1% used sedatives or tranquilizers. 5.9 million people over the age of 12 abuse sedatives and/or tranquilizers which are used as a sleep aid, to relieve tension, or use recreationally. (NCDAS, 2023). Legal drugs have a positive impact on people's lives, but they can have a negative impact on the user and in turn on the workplace. This is why the government and many companies have created safety procedures for the use of legal drugs.

1.3.2 Illegal Drugs

It is also important to note that the consumption of illegal drugs has been increasing in the United States and it has become a significant problem. In the United States, 59.3 million, or 21.4% of people 12 and over have used illegal drugs or misused prescription drugs within the last year. "Among Americans aged 12 years and older, 37.3 million were current illegal drug users (used within the last 30 days) as of 2020" (NCDAS, 2023). The problem with this is that many people who use these drugs, tend to abuse the use of illegal drugs and they end up with an addiction/abuse disorder. Out of all the individuals that use illegal drugs, 25.4% of illegal drug users have a drug disorder and 24.7% of those with drug disorders have an opioid disorder; this includes prescription pain relievers or "painkillers" and heroin). This also includes that 9.5 million or 3.8% of adults over the age of 18 have both substance use disorder (SUD) and a mental illness (NCDAS, 2023). This definitely brings problems to the individual, but it also might have an effect on their families, and their work performance. It is especially important to understand that drug users might cause accidents in their workspace due to impairment.

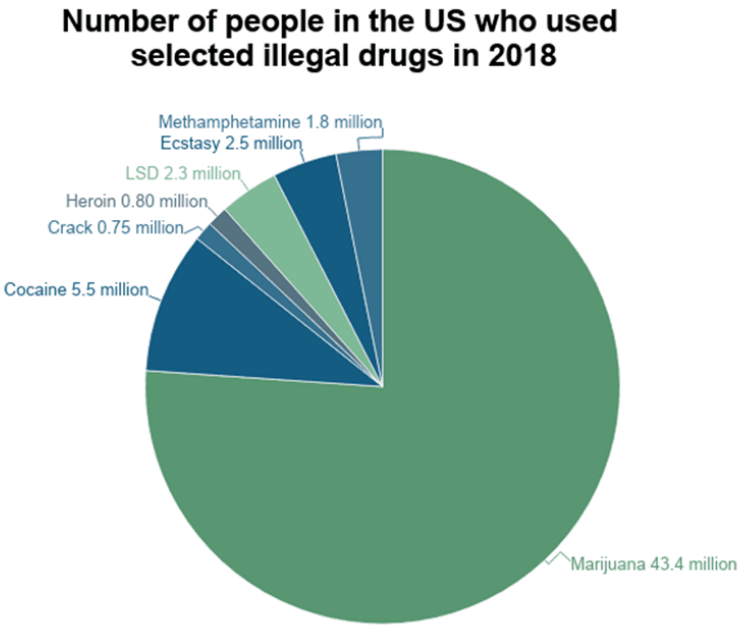

Figure 1.3.2: *Graph representing the number of people in the US who used selected illegal drugs in 2018 (*NCDAS, 2023).

Drug use helps contributes to economic and societal problems. It is common to have government involvement and legislation in order to control the use of substances. This is viewed differently within the country's population and, it is important to understand how governments and organizations deal with these drug legislations and legalization.

1.3.3 Government Involvement

The United States government creates multiple laws, acts, policies, and programs to help control the use, sale, possession, and distribution of drugs. The government has focused on fighting the drug war and creating programs to help individuals with substance abuse disorders or addictions. In 2022, President Biden and the White House released a statement, where they explained that the plan was to help individuals affected by drugs and fight drug trafficking. "The Strategy focuses on two critical drivers of the epidemic: untreated addiction and drug trafficking. It instructs federal agencies to prioritize actions that will save lives, gets people the care they need, goes after drug traffickers' profits, and make better use of data to guide all these efforts"(The United States Government, 2022). The most common way that the US government intervenes with drug use is in fact their policies and their laws.

1.3.4 Drug Legislation

Each country establishes its own laws and regulations in order to regulate the use and manufacturing of drugs. In the United States, there are multiple acts and laws to control the possession, trafficking, and manufacturing of drugs. Each state has the power to create and have its own laws regarding the use of drugs, but there are federal laws that supersede state laws - including those regarding the medical and recreational use of marijuana (AACES, 2022). Federal drug laws in the United States do regulate drug testing for private companies. Specifically, the Drug-Free Workplace Act of 1988 requires certain employers that receive federal grants or contracts to establish drug-free workplace policies and to provide for drug testing of employees. Additionally, the Americans with Disabilities Act (ADA) permits employers to conduct drug testing of employees under certain circumstances, such as when an employee's drug use could pose a threat to the safety of themselves or others in the workplace.

There are also other federal laws and regulations that can impact drug testing in the private sector, including the Controlled Substances Act (CSA) and the Occupational Safety and Health Act. The CSA, for example, regulates the use and distribution of controlled substances, which can include drugs that are commonly tested for in workplace drug tests. OSHA, on the other hand, requires employers to provide a safe and healthy workplace for their employees, and drug testing may be a part of an employer's efforts to maintain a safe workplace.

However, it is important to note that the specific rules and regulations around drug testing in the private sector can vary depending on the industry, the state in which the company is located, and other factors. Employers should consult with legal counsel and stay up-to-date on the latest federal and state laws and regulations to ensure they are in compliance with all applicable rules around drug testing in the workplace.

1.3.5 Federal Laws

Federal laws in the United States exist to control the use, possession, and distribution of various legal and illegal drugs that exist. Possession, use, or distribution of illicit drugs is prohibited by federal law. Strict penalties are provided for drug convictions, including mandatory prison terms for many offenses. Penalties increase significantly where the use of the illicit drugs results in death or serious bodily injury. Different federal agencies work with state and local law enforcement in order to have effective control over these substances. As mentioned before, each state has its own drug laws, but due to the Controlled Substances Act,

law enforcement can enforce federal drug laws in any jurisdiction regardless of the laws of any state.

1.3.6 Controlled Substances Act

The Controlled Substances Act was created in 1970 and it has been used by law enforcement to decrease drug use and dependence among Americans by regulating the production, sale, purchase, and use of many drugs. "This act gives authority to the Drug Enforcement Administration (DEA) to monitor and control the use of substances, both legal and illegal." (USHA, 2015)

Due to the large number of substances that exist, the CSA puts each substance into five categories, also called schedules. By doing this, the substances are classified into a specific group, helping law enforcement and the medical community understand their nature. "This placement is based upon the substance's medical use, the potential for abuse, and safety or dependence liability" (DEA, 2018). The higher the classification, the least potential for abuse and damage to an individual. Each drug is classified as a controlled substance, but not all are illegal (USHA, 2015).

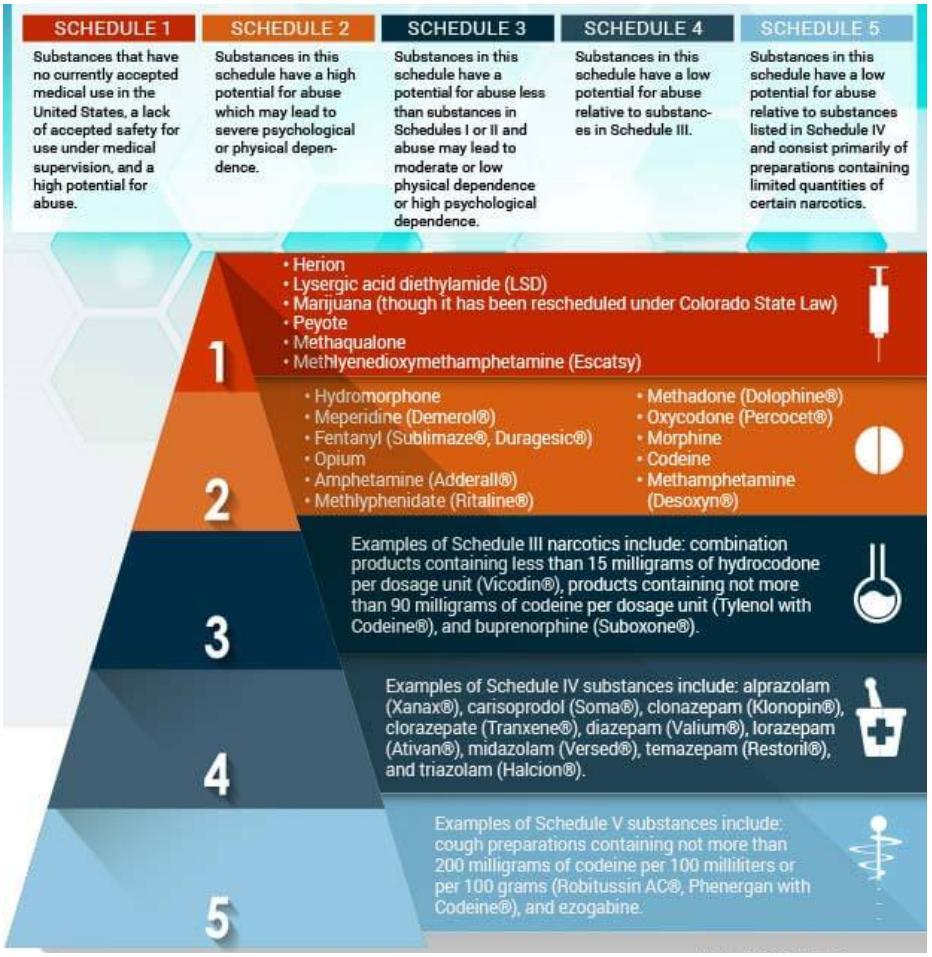

Figure 1.3.6: *The drug schedule classifications pyramid (Wolfadmin, 2022).*

1.3.7 - State Drug Laws

Each state has individual laws regarding drug offenses, and these laws can be very different. States each have their own statutory authorities, scheduling bodies, and controlled substance acts, though federal agencies can take over jurisdiction at any time. In order to understand how states enforce and control substances, it is necessary to research each one of the states and its laws.

1.3.8 - Marijuana Laws

" Federal laws consider marijuana to be a Schedule I drug, with penalties for the possession, distribution, growth, or sale of marijuana. However, various states have established laws and regulations for medicinal and even recreational use of marijuana" (AACES, 2022).

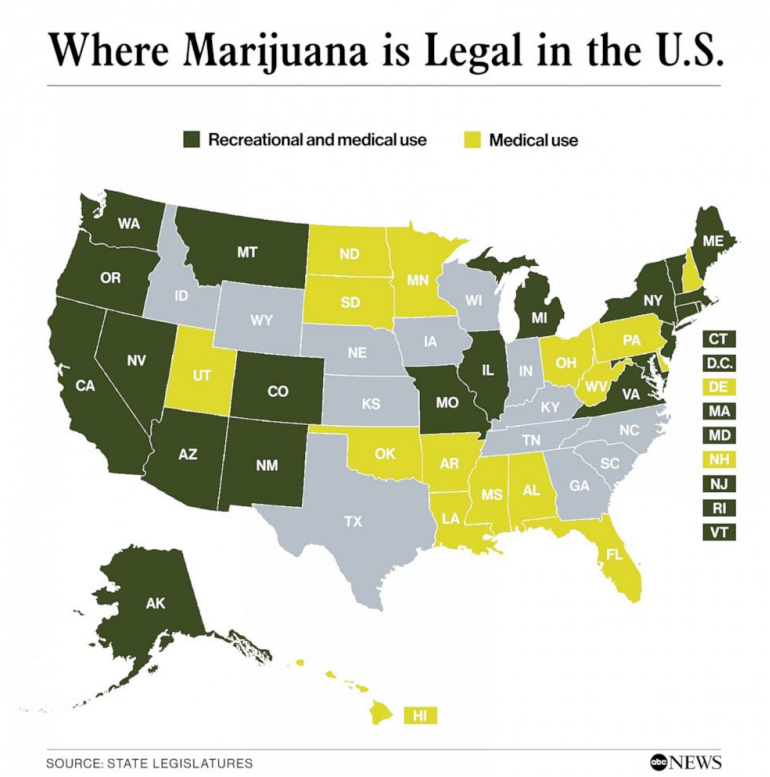

Figure 1.1: *Map of the United States where marijuana is legal for recreational use, medical use, and illegal as of 2022 (Pereira, 2022).*

In order to legalize and decriminalize this drug, there have been multiple attempts to pass bills, and legalize it via a ballot question, many of which have not succeeded. An important thing to know is that "The House passed a marijuana decriminalization bill on

April 1, 2022, and months later, several senators – including Senate Majority Leader Chuck Schumer – introduced the Cannabis Administration and Opportunity Act, which would federally decriminalize weed, as reported by Marijuana Moment. The bill's future in the Senate is uncertain."(The United States Government, 2022).

1.3.9 Drugs and the Workplace

When looking at accidents that occur in the workplace, many of them are caused due to individuals being impaired. According to the National Safety Council, workplace impairment is anything that could impede one's ability to function normally or safely – from chemical substances, such as alcohol, opioids, or cannabis, to physical factors like fatigue, as well as mental distress and social factors like stress (NSC, 2022). Individuals that use drugs, both legal and illegal unfortunately can go to work impaired. An estimated 67% of people with a substance use disorder are in the workforce, which demonstrates this is a serious problem (SAMSHA, 2022).

Employers have been implementing different rules, policies, and programs inside their organizations to avoid having impaired employees. Many organizations tend to create education programs about the use of drugs, in order to educate workers on their effects and risks. This normally helps educate workers about their drug use and it can help create a safer workplace. Apart from that, many, if not all, organizations create and use a "Drug-Free Workplace Policy" where they write all the rules employees need to follow regarding drug use. This includes the statement of prohibition of drug use in the workplace, the prohibition of working while impaired, the different ways and reasons why an employee would be drug tested, help and treatment regarding an employee using drugs, and education programs. The idea of these policies is to prohibit the employee from using drugs inside and outside of the workplace, in order for them not to show up to work impaired and cause accidents.

It is important that organizations are flexible when it comes to creating and modifying their programs and policies since we live in a changing world. Employers also need to be aware of changes that might appear in state and federal laws and update policies and programs. The ongoing changes in federal and state laws are important for organizations since they can create new opportunities on how to approach impaired workers. For example, it has been mentioned before that drugs are part of the reason why individuals suffer from an impairment, and one of those drugs that cause impairment is marijuana. This type of drug might become legal in many states, if not all, which can bring organizations a problem since more people will be using this drug. The more drugs are used, the more impaired workers

there are going to be, and the more opportunities to create and use new policies, laws, and technologies in the workplace to avoid impairment-related accidents.

Being impaired can present fitness for duty concerns and might impact employee health, safety, and well-being when in the workplace. It is well known that impairment has many types of signs and symptoms that could indicate that an individual is impaired but can vary greatly and be difficult to vet. These symptoms could be personality changes, erratic behavior, dilated or constricted pupils, isolation, bloodshot eyes, consistent tardiness, absenteeism, involvement in accidents, and more (CCOHS, 2022). Identifying an individual with these symptoms is important, but it is not an easy task, and sometimes impaired individuals do not show some or all of these symptoms. Employers have been taking action and turning to technology to identify and address impairment in the workplace. One movement is the consideration of “Impairment Detection Technology” (IDT). “This type of technology can provide a promising alternative to drug testing, which lacks the ability to identify impairment in real-time and does not address the impairment risk presented by factors other than chemical substances"(National Safety Council, 2022). Implementing IDT is important for organizations to create a safer workplace. IDT could be the next big solution to create a safer workplace for any type of organization, and with the coming changes in drug laws and increased drug use in the United States, investing in devices like this can help avoid many future accidents.

1.4 Real-Time Impairment Detection

Real-Time Impairment Detection is a technology-driven approach to identifying and addressing worker impairment in real-time. It uses a combination of sensors and algorithms to monitor workers' physiological and behavioral data, such as heart rate, body temperature, and movement patterns, to detect changes that may indicate impairment. Once detected, the system can alert supervisors or safety personnel to intervene and take appropriate action to prevent accidents and injuries. Real-Time Impairment Detection has the potential to significantly improve workplace safety by providing a proactive approach to identifying and managing impairment. By detecting impairment in real-time, employers can take immediate action to address the issue, such as providing support and resources to help the worker overcome the impairment or removing the worker from the hazardous work environment. This technology can also help to reduce the stigma associated with impairment and promote a culture of safety and support in the workplace.

2 Targeted Industries

The construction, mining, and transportation industries are vital to the modern economy and society, but they also pose significant risks to the safety and well-being of workers and the general public. Accidents in these industries can have serious consequences, including injuries, fatalities, and damage to property and the environment. Organizations have been implementing different safety practices and safety equipment in order to improve workplace safety. Government intervention has also been part of the solution to the accidents that have been occurring, with the government creating regulations and programs to help with workplace safety.

2.1 Construction

The construction industry is one of the most important sectors of the United States economy. It accounts for roughly 4.3% of the nation's total GDP and is responsible for the creation of millions of jobs in the country (Kolmar, 2022). “Approximately 7.5 million people are employed by the construction industry, as of January 2022 - that’s about 4.8% of the U.S workforce” (Kolmar, 2022). It is a highly dynamic and diverse industry that plays a major role in the growth and development of the nation. From building bridges and roads to constructing homes and commercial buildings, the construction industry is responsible for a wide range of projects that are essential for the country's economic and social development. Even if the construction industry is very important for the nation, it is a very dangerous industry, where multiple employees get injured and, in some cases, die.

2.1.1 Safety Data

The construction industry is one of the most hazardous industries in the world. Nonfatal injuries in the construction industry accumulated a total of 779,430 non-fatal accidents. The data has been volatile from 2013 through 2020. The fatal injuries between the years 2011 and 2020 accumulated a total of 9,247 accidents. It has been steadily increasing every year between 2013 and 2020 (Teicher, 2021).

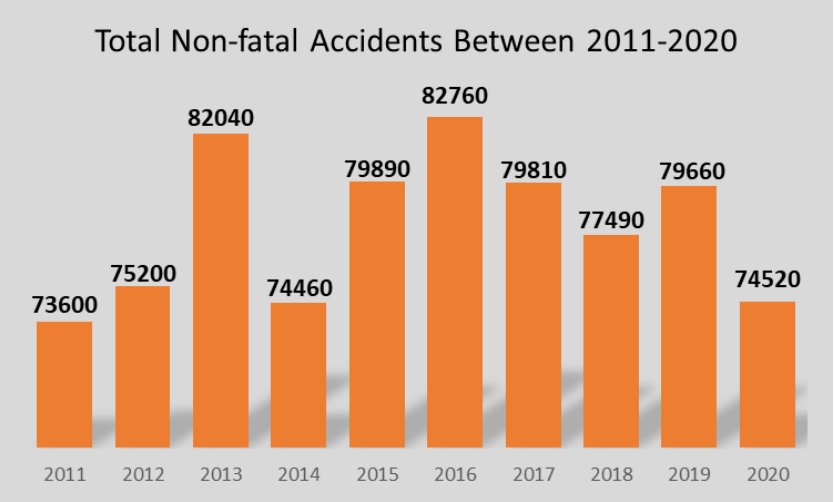

Figure 2.1.1: *Bar chart made with data from the National Safety Council representing the total non-fatal accidents that occurred in the construction industry between 2011-2020.*

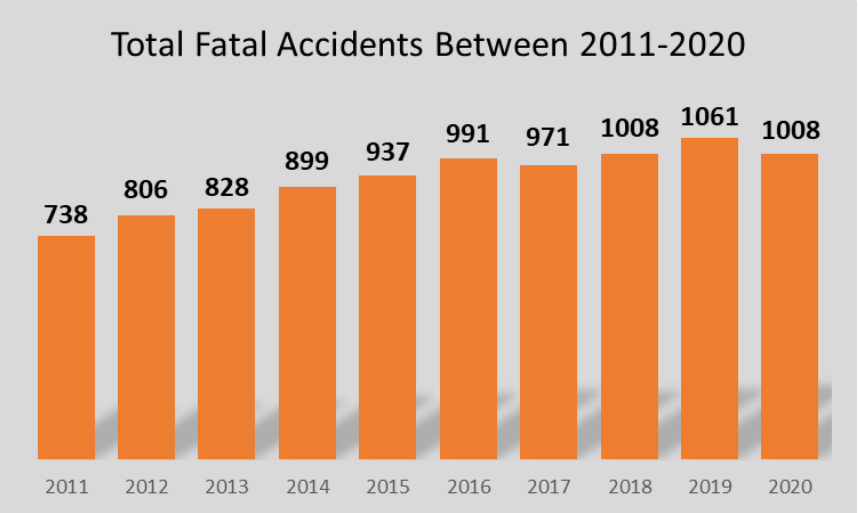

Figure 2.1.2: *Bar chart made with data from the National Safety Council representing the total fatal accidents that occurred in the construction industry between 2011-2020.*

According to OSHA, between the years 2011 and 2020, multiple accidents occurred, accumulating to a total of 10,233 accidents. These deaths represented 20.7% of total workplace fatalities in the United States. Falls slips, and trips were the most frequent type of fatal event in the construction industry, representing 37.9% of all fatalities (BLS, 2021). When looking at fatal accidents, falls, slips and trips accumulate 16% of the fatal accidents that occurred during that time frame. This is followed by falls to a lower level (16% of accidents) and transportation incidents (12% of accidents) (NSC, 2021).

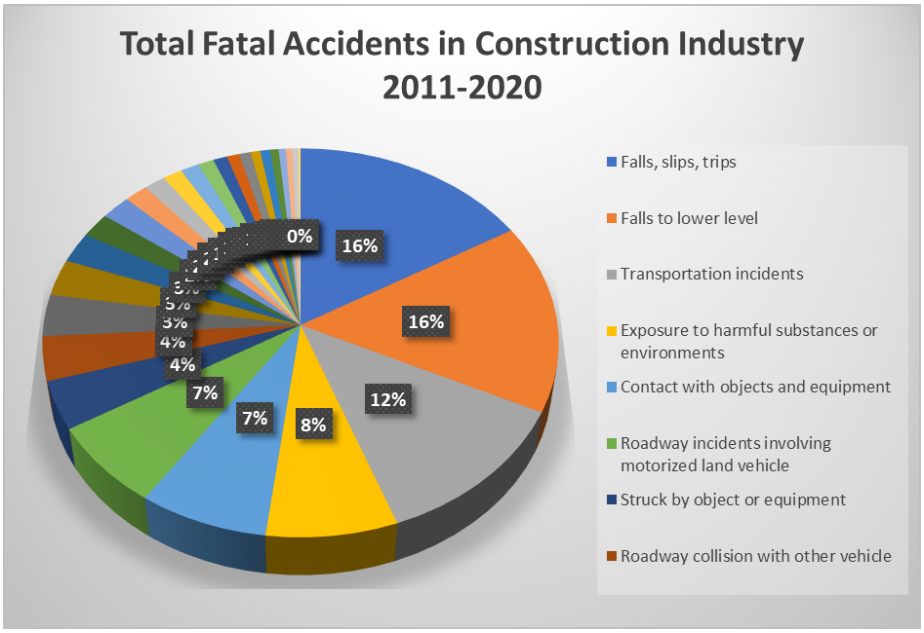

Figure 2.1.3: *Pie chart made with data from the National Safety Council representing the total fatal accidents that occurred in the construction industry and their reasons between 2011-2020.*

It is also important to understand that apart from the fatal accidents that occur in this industry, there are multiple non-fatal accidents. Between 2011 and 2020, the major category of accidents has been contact with objects/equipment, causing 19% of the accidents, followed by falls, slips, and trips (17% of the accidents), and overexertion and bodily reaction (16% of the accidents) (NSC, 2021). "Falls, slips, and trips in 2019 accounted for 32% of nonfatal injuries involving days away from work in the private construction industry (25,460 cases of 79,660)" (BLS, 2021). In addition, the construction industry also has a high rate of injuries caused by exposure to hazardous substances, such as asbestos and lead. Furthermore, the construction industry also has a higher rate of work-related musculoskeletal disorders (MSDs) caused by repetitive motions, awkward postures, and heavy lifting.

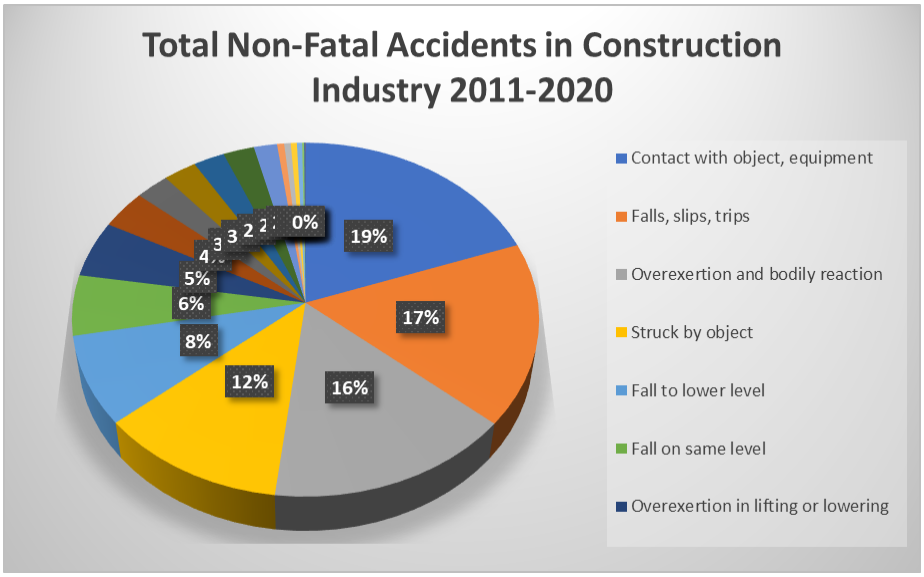

Figure 2.1.4: *Pie chart made with data from the National Safety Council representing the total Non-Fatal accidents that occurred in the construction industry and their reasons between 2011-2020.*

These injuries can lead to long-term health problems and can even be fatal. In order to prevent accidents and injuries in the construction industry, it is important for employers to provide proper training and equipment, implement safety protocols, follow governmental regulations and policies, and conduct regular safety inspections.

2.1.2 Accidents and Their Cost

Accidents in the construction industry not only have a human cost, but also a significant financial cost. A study by the National Safety Council (NSC) found that the total cost of fatal and nonfatal construction accidents in the United States is over $10 billion per year (NSC, 2020). This includes direct costs such as medical expenses and workers' compensation, as well as indirect costs such as lost productivity and the cost of recruiting and training replacement workers (NSC, 2020).

Furthermore, according to a study by the Construction Industry Research and Policy Center (CIRPC), the total cost of construction accidents in the United States is estimated to be as high as $200 billion per year when indirect costs are taken into account (CIRPC, 2020). This includes costs such as lost productivity, increased insurance premiums, and the cost of recruiting and training replacement workers (CIRPC, 2020).

These statistics demonstrate that accidents in the construction industry are a significant problem, both in terms of human cost and financial cost. The high rate of

accidents in the construction industry highlights the need for effective safety measures to protect workers and reduce the cost of accidents. Employers in the construction industry must take steps to improve safety on the job, such as providing training, implementing safety procedures, and ensuring that workers have access to the proper safety equipment.

2.1.3 Safety Practices and Safety Equipment

The construction industry has a lot of hazards, and working towards creating a safer environment is a key thing in the industry. In order to create this safer environment in the workplace, there are government organizations that create policies, rules, and more regarding safety measures and the safety equipment that needs to be used. Occupational Safety and Health (OSH) Act of 1970 (USDL, 2018) Covers safety in the construction industry. Following this the standards, and regulations presented in this act, are one of the key things that organizations in the business industry need to do. By following and giving attention to these standards, businesses in the industry will be able to:

- Ensure that construction sites are free of recognized hazards as much as possible.
- Comply with all standards, rules, and regulations issued under the OSH Act. (USDL, 2020)
- Examine working conditions to ensure they comply with OSHA standards.
- Provide safe tools and equipment and maintain them to the best possible standard.
- Ensure accurate warnings are in place to highlight potential hazards to workers, including color codes, posters, or labels).
- Have in place clear operating procedures which are updated as required and communicated clearly to employees.
- Ensure that training is given before any work is done on-site and that training is provided in a language and vocabulary that workers understand, which is especially important given the high percentage of immigrant workers in the construction industry.
- Have a hazard communication program if employees work with hazardous chemicals.
- Provide medical exams and training. (ABAD, 2021)

Another important consideration that has lately received more attention is the mental health of the workers in this industry. There is a growing importance on taking care of employees' mental health, which creates an additional area of focus for businesses.

The Occupational Safety and Health Administration also creates regulations regarding the safety equipment that is necessary for every construction site. Every

organization working in this industry needs to follow these policies. In their construction 29 CFR 1926 regulations, OSHA goes over many different types of safety equipment that need to be present in the different construction sites. There are four sections that include subsections regarding safety equipment. The following chart shows the different sections and what they focus on regarding safety equipment (USDL, 2020).

Construction (29 CFR 1926)	
1926 Subpart C - General Safety and Health Provisions	1926.28, Personal protective equipment.
1926 Subpart E - Personal Protective and Life Saving Equipment	1926.95, Criteria for personal protective equipment.
	1926.96, Occupational foot protection.
	1926.100, Head protection.
	1926.101, Hearing protection.
	1926.102, Eye and face protection.
	1926.103, Respiratory protection.
	1926.104, Safety belts, lifelines, and lanyards.
	1926.105, Safety nets.
	1926.106, Working over or near water.
	1926.107, Definitions applicable to this subpart.
1926 Subpart M	1926.500, Scope, application, and definitions applicable to this subpart.
	1926.501, Duty to have fall protection.
	1926.502, Fall protection systems criteria and practices.
	1926.503, Training requirements.
1926 Subpart P - Excavations	1926.651, Specific Excavation Requirements.
	1926.652, Requirements for protective systems.

Figure 2.1.3: *Chart listing the sections from OSHA's 29 CFR regulations regarding safety equipment.*

OSHA, apart from implementing the requirements mentioned before, also works on gathering data from accidents and illnesses on the job site. By gathering data, they are able to create different ways to solve and avoid having those types of injuries again. The idea is to

give the different businesses a new way to prevent accidents that happened before from happening again.

2.2 Transportation

The transportation industry in the United States is a critical part of the American economy. “The U.S. transportation industry is worth $1.26 trillion as of 2021” (Flynn, 2023). It encompasses a wide variety of businesses and organizations, from trucking and aviation to rail and public transit. The industry plays an essential role in moving people and goods around the country and is responsible for billions of dollars in economic activity each year. The industry is constantly evolving, with new technologies being developed, new regulations being implemented, and new infrastructure projects being launched. The transportation industry creates a vast amount of jobs in the United States, where 14.3 million Americans work in the transportation & warehousing industry as of 2020 (Flynn, 2023). The transportation industry in the United States is an integral part of our economy and is essential to our nation's continued growth and prosperity. Like the construction industry, as big and as important as the transportation industry is, it comes with a lot of risks and accidents that occur daily.

2.2.1 Safety Data

The transportation industry includes trucking, aviation, and rail transportation and is known for being a dangerous industry with a high rate of accidents. According to the National Transportation Safety Board (NTSB), the transportation industry accounted for 24.8% of all worker fatalities in the United States in 2019. The most common causes of transportation accidents include vehicle crashes, collisions, and derailments. In 2019, the Federal Motor Carrier Safety Administration (FMCSA) reported that 4,142 large trucks and buses were involved in fatal crashes. In addition, the transportation industry also has a high rate of injuries caused by exposure to hazardous substances, such as fuel and chemicals, and also has a higher rate of accidents caused by equipment failure and human error. These accidents can lead to severe injuries and even death. In order to prevent accidents and injuries in the transportation industry, it is important for employers to provide proper training and equipment, implement safety protocols, and conduct regular safety inspections.

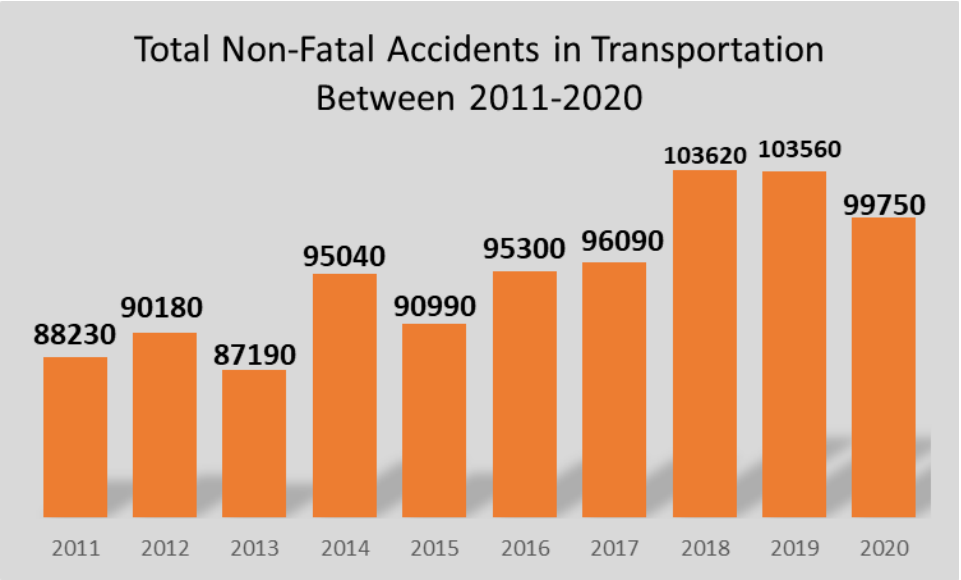

Figure 2.2.1: *Bar chart made with data from the National Safety Council representing the total non-fatal accidents that occurred in the transportation industry between 2011-2020.*

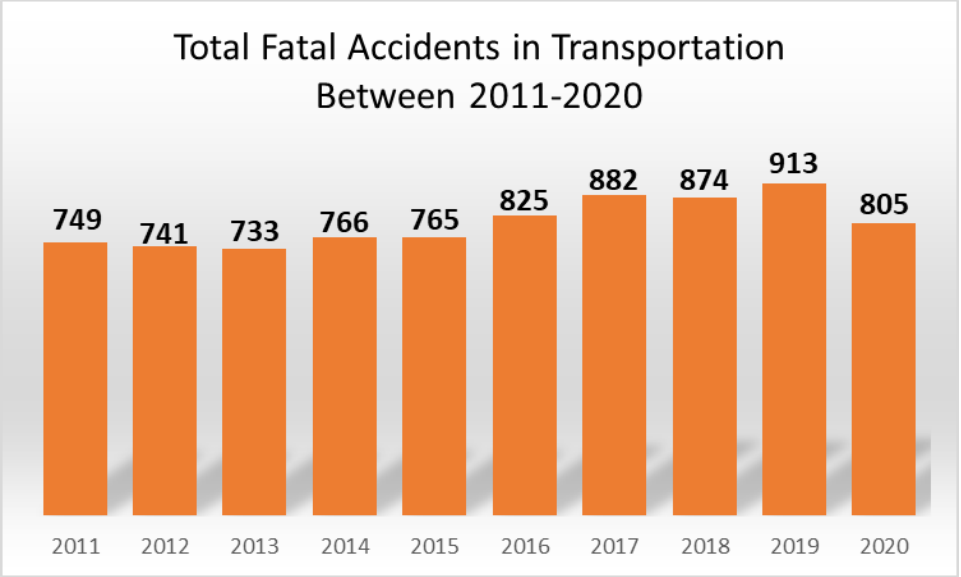

Figure 2.2.2: *Bar chart made with data from the National Safety Council representing the total fatal accidents that occurred in the Transportation industry between 2011-2020.*

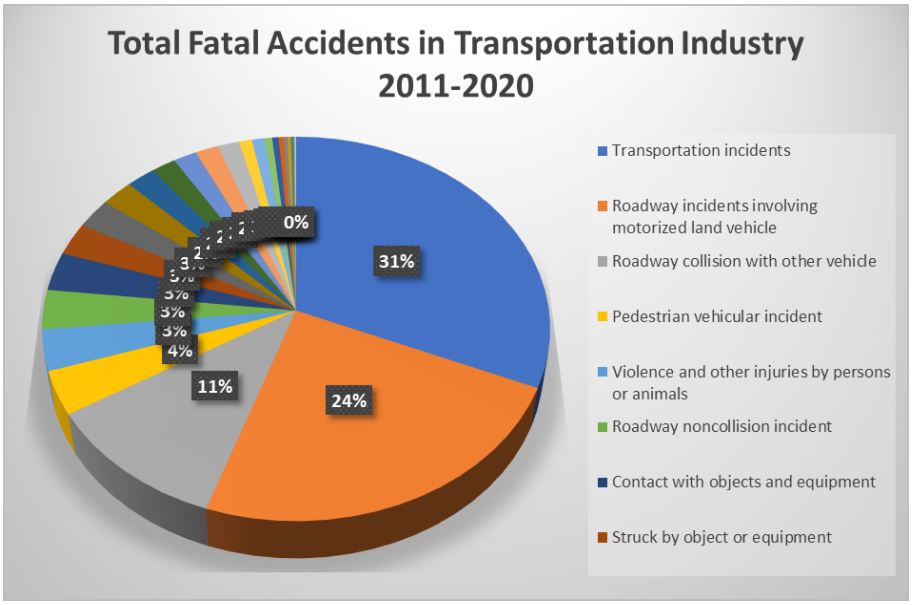

Figure 2.2.3: *Pie chart made with data from the National Safety Council representing the total Fatal accidents that occurred in the transportation industry between 2011-2020.*

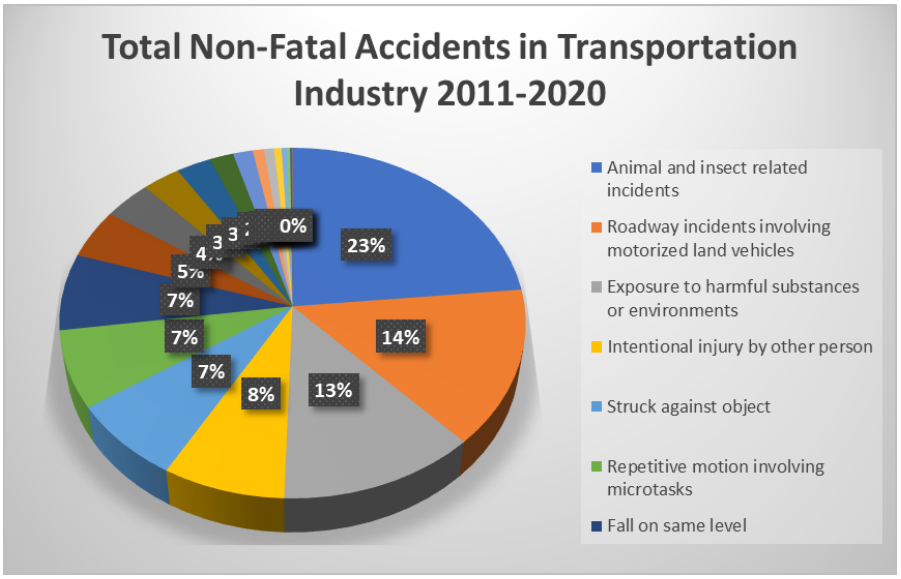

Figure 2.2.4: *Pie chart made with data from the National Safety Council representing the total Non-Fatal accidents that occurred in the transportation industry between 2011-2020.*

2.2.2 Accidents and Their Cost

According to the National Highway Traffic Safety Administration (NHTSA), in 2018, there were 36,560 fatalities due to motor vehicle crashes in the United States. This number is a 2.4% decrease from 2017, but still represents a significant cost to society. In addition to the

human cost, the financial cost of motor vehicle crashes is estimated to be $836 billion annually. (NHTSA , 2019)

In 2018, there were 564 aviation accidents in the United States, resulting in 471 fatalities. NTSB estimates that the cost of aviation accidents in the United States is approximately $7.2 billion annually. (National Transportation Safety Board, 2019)

Rail accidents are also a significant source of financial losses in the transportation industry. In 2018, there were 2,077 rail accidents in the United States, resulting in 803 fatalities. The Federal Railroad Administration (FRA) estimates that the cost of rail accidents in the United States is approximately $2.3 billion annually. (Federal Railroad Administration, 2019)

Finally, maritime accidents are also a significant source of financial losses in the transportation industry. In 2018, there were 1,845 maritime accidents in the United States, resulting in 645 fatalities. The U.S. Coast Guard estimates that the cost of maritime accidents in the United States is approximately $2.2 billion annually. (U.S. Coast Guard, 2019)

Overall, accidents in the transportation industry are a significant source of financial losses. In addition to the human cost, the financial cost of motor vehicle, aviation, rail, and maritime accidents in the United States is estimated to be approximately $14.3 billion annually. It is important for transportation companies to take steps to reduce the number of accidents and the associated costs. This can include implementing safety protocols, investing in safety technology, and providing safety training for employees.

2.2.3 Safety Practices and Equipment

The transportation industry in the United States is subject to safety regulations to ensure the safety of passengers, workers, and the general public. All transportation companies, from airlines to trucking companies, must adhere to safety standards set by the FMCSA. These regulations cover various safety topics, such as driver qualifications, vehicle maintenance, and drug and alcohol testing. The Department of Transportation (DOT) and OSHA work towards creating regulations, training programs, and more, in order to help create a safer workplace environment for workers in the transportation industry.

In order to achieve its mission, DOT has created a Safety Team. The Safety Team carries out a number of activities to coordinate and execute DOT’s safety initiatives, including; :

- Reviews and analyzing the safety implications of domestic transportation policy to provide a basis for advising DOT leadership actions and decisions;

- Conducting analyses and recommending policies for reducing transportation fatality and injury rates;
- Develops, coordinates, and evaluates public policy on transportation safety issues;
- Develops and reviews transportation legislation and regulations, and coordinates national transportation policy initiatives relating to safety matters;
- Monitors compliance procedures for handling the National Transportation Safety Board (NTSB) recommendations by the Operating Administrations, and manages DOT's response to the NTSB Most Wanted List;
- Engages with stakeholders on issues impacting a wide range of safety issues.
- Looks for opportunities to advance the Department's safety mission. (Teicher, 2021)

In order to fix or approach a safer workplace, the DOT tends to take a proactive approach. They research and investigate accidents, illnesses, and more and by looking for solutions on how to change and solve the problem. The DOT also works with other organizations and branches of government that create and follow regulations in their specific department, and coordinate with the Operating Administrations such as the Federal Aviation Administration (FAA), the Federal Highway Administration (FHWA), the Federal Motor Carrier Safety Administration (FMCSA), the Federal Railroad Administration (FRA), the Federal Transit Administration (FTA), the Maritime Administration (MARAD), the National Highway Traffic Safety Administration (NHTSA), and the Pipeline and Hazardous Materials Safety Administration (PHMSA) on the safety activities that further the department's goal to reduce the number of individuals injured and killed as a result of transportation" (Teicher, 2021). Currently, the safety team works with the rest of the department to perform research on different topics including human behavior, emerging and automated technologies, data, federal relationships with state, regional, and local government, regulations and enforcement, and communications with the public and stakeholders (more information in the link below).

The DOT is also moving towards using "big data" as a source to create new safety and health initiatives. "The advent of "big data" and innovative data analytics presents an opportunity to combine traditional safety databases with new data sources in order to better predict safety risk. The Office has been working with the Office of the Chief Information Officer within OST and the OAS to conduct and encourage analyses that identify and illuminate DOT safety risks using multimodal insights that combine DOT and cross-governmental data" (Teicher, 2021). One thing that stands out about OSHA is that they tend to work mainly in creating handouts and presentations to individuals that work in the

transportation industry, as well as individuals that could affect those workers, such as automobile drivers. This is in order to create a better/safer workplace environment for the transportation industry employees. It is important to notice that OSHA, just like the DOT, works with other organizations such as the U.S Coast Guard, the Department of Homeland Security (DHS), the Federal Railroad Administration (FRA), the National Highway Traffic Safety Administration (NHTSA), the Federal Aviation Administration (FAA), the DOT and many more. They do this in order to help other organizations and regulate other means of transportation to create a safer working environment.

2.3 Mining

The mining industry in the United States has been a major part of the country's economy. "In 2020, U.S. mines produced mineral raw materials worth $82.3 billion" (NMA, 2021). The sector has contributed significantly to the country's production of metals, minerals, and energy sources. Moreover, it has also been a major source of employment opportunities in many regions of the country, nearing almost one million jobs.. "With over 370,000 Americans directly employed through minerals mining today, and more than 590,000 indirectly employed, the industry is putting hundreds of thousands of people with diverse backgrounds and interests to work" (NMA, 2021). The United States is one of the world's leading producers of coal, copper, and other minerals. The sector is also a major contributor to the country's production of petroleum and natural gas. In addition, it has been an important source of technological advancements, particularly in areas such as automation and robotics. As a result, the mining industry in the United States has become increasingly competitive and advanced over the years.

2.3.1 Safety Data

The mining industry is known for being a dangerous industry with a high rate of accidents. According to MSHA, the mining industry accounted for 8% of all worker fatalities in the United States in 2019. The most common causes of mining accidents include falls, being struck by an object, and explosions or fires. In 2019, MSHA reported that falls of ground and powered haulage accounted for the most mining fatalities and that a total of 27 miners died on the job. Between the years 2011 and 2020 around 3200 people died in mining accidents. Out of all the fatal accidents, 20% occurred due to transportation incidents, followed by roadway incidents involving motorized land vehicles.

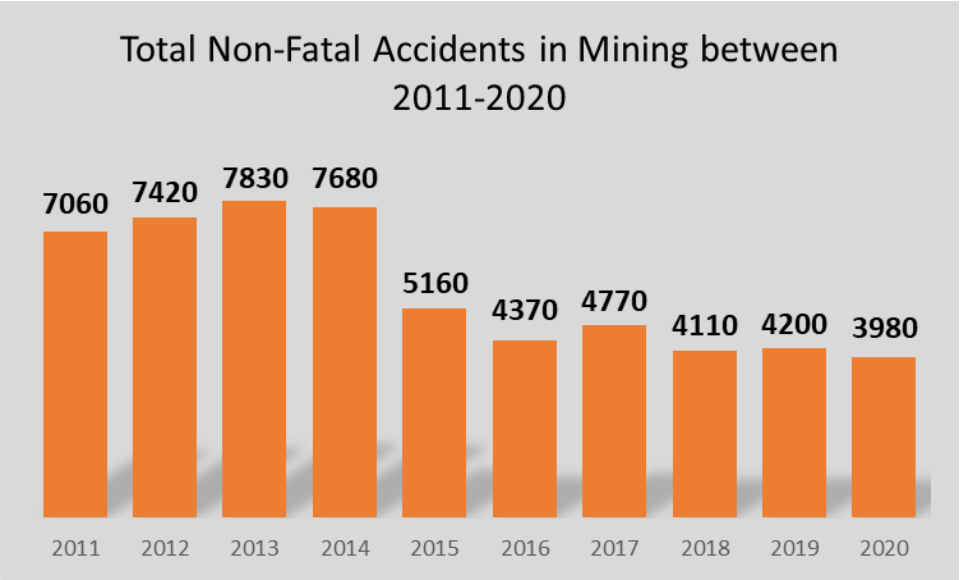

Figure 2.3.1: *Bar chart made with data from the National Safety Council representing the total non-fatal accidents that occurred in the Mining industry between 2011-2020.*

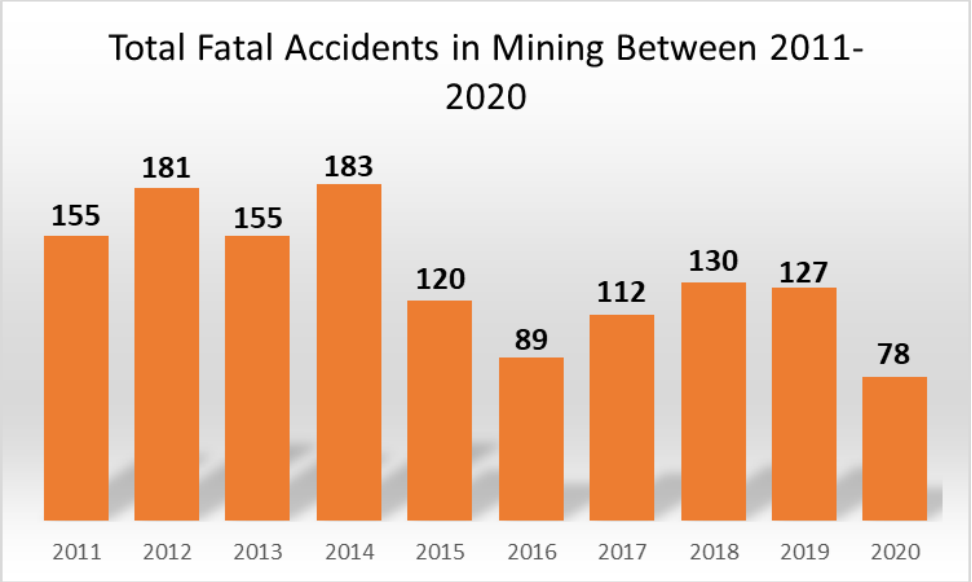

Figure 2.3.2: *Bar chart made with data from the National Safety Council representing the total fatal accidents that occurred in the mining industry between 2011-2020.*

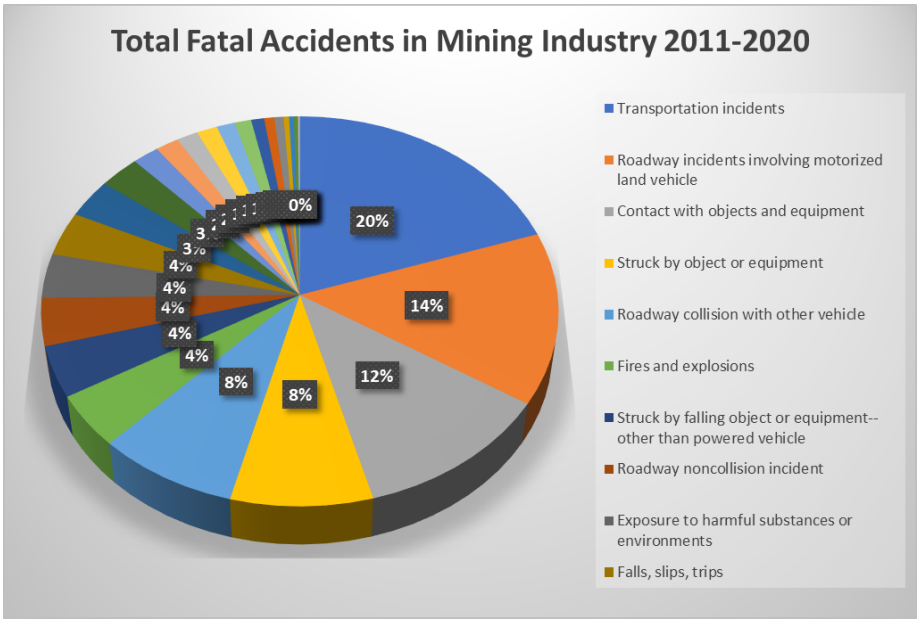

Figure 2.3.3: *Pie chart made with data from the National Safety Council representing the total Fatal accidents that occurred in the mining industry between 2011-2020.*

In addition to fatal accidents in the mining industry, there is still a high rate of non-fatal accidents that occur. Accidents that occur in the mining industry include injury by a person, unintentional or intent unknown, transportation incidents, roadway incidents involving motorized land vehicles, fires/explosions, falls, slips, trips, exposure to harmful substances or environments, contact with object/equipment, being, struck by/or against an object, caught in the object, equipment, material, overexertion, and bodily reaction, overexertion in lifting or lowering and repetitive motion involving microtasks. Between 2011-2020, contact with objects/equipment has been the reason for 20% of the accidents, followed by falls, slips, and trips with accumulated 19% of the accidents. Then, overexertion and bodily reaction, which could be related to impairment, have been a reason for an accident in 13% of the accidents (NSC, 2021). The data is presented in the graphs below where one can see the different percentages and total of accidents that have occurred between the years 2011 and 2020.

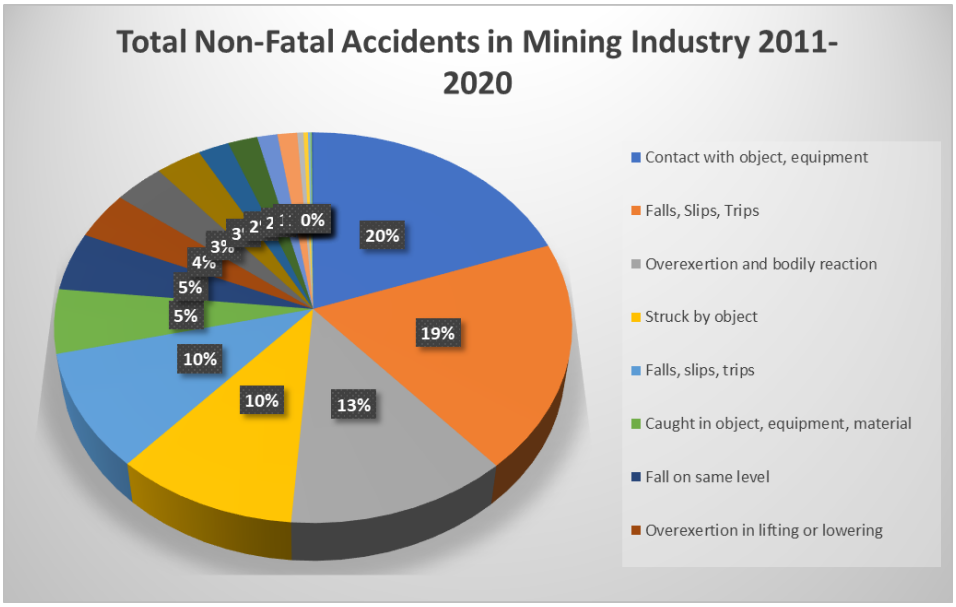

Figure 2.3.4: *Pie chart made with data from the National Safety Council representing the total non-fatal accidents that occurred in the mining industry between 2011-2020.*

In order to prevent accidents and injuries in the mining industry, it is important for employers to provide proper training and equipment, implement safety protocols, and conduct regular safety inspections.

2.3.2 Accidents and Their Cost

According to the International Labor Organization (ILO), the mining industry is one of the most dangerous industries in the world, with an average of 13 fatalities per 100,000 workers in 2018. (ILO, 2020) This is significantly higher than the global average of 3.3 fatalities per 100,000 workers.

According to NIOSH Mining, from 2008 until 2017 there were 404 fatal accidents with a median cost of $1.42 million per fatality and a total societal cost of $554 million. “Researchers, occupational health professionals, workplace safety organizations, and labor unions have proven to be willing and avid users of past NIOSH estimates. This Technical Guide reviews the Fatalities Cost in Mining web app, including its development and how it can be used to estimate the economic burden of fatal mining injuries" (CDC, 2020).

A report by NIOSH indicates the total cost of mining accidents in the United States in 2018 was estimated to be $1.2 billion. (NIOSH, 2018) This includes direct costs such as medical expenses, lost wages, and legal fees, as well as indirect costs such as lost productivity, increased insurance premiums, and damage to equipment.

The human costs of mining accidents can be even more devastating. In addition to the loss of life, mining accidents can cause serious injuries, such as amputations, paralysis, and traumatic brain injuries. These injuries can have long-term effects on the victims and their families, including physical and emotional pain, financial hardship, and loss of quality of life.

In order to reduce the number of mining accidents and their associated costs, it is important for mining companies to take steps to improve safety. This includes implementing safety protocols, providing safety training, and investing in safety equipment. Additionally, mining companies should ensure that their workers are properly compensated for any injuries or fatalities that occur on the job.

Finally, governments should also take steps to ensure that mining companies are held accountable for any accidents that occur. This includes enforcing safety regulations, conducting regular safety inspections, and imposing fines and other penalties for violations.

2.3.3 Safety Practices and Safety Equipment

The mining industry has very dangerous work due to the extreme temperatures, air quality, danger due to the equipment they use, and more. One of the most important safety practices implemented in US mines is MSHA regulation. MSHA enforces and monitors safety standards in the mining industry. The regulations cover a variety of topics, including ventilation, dust, noise, heat, cold, water, and emergency response. These regulations have been implemented and created by MSHA in Title 30 of the Code of Federal Regulations (MSHA, 2020). This code basically explains and implements standards that should be followed by organizations that are part of the mining industry. MSHA has also developed various training and education programs to ensure that miners are knowledgeable about safety procedures which are mentioned later in this section.

Many of these safety changes and implementations are not only made by MSHA but by other organizations that work towards creating safer environments in multiple industries. These organizations include NIOSH, OSHA, the NSC, and the American Society of Safety Professionals (ASSP). These are the most common organizations that work towards helping different businesses implement new measures to have a safer workplace. For example, NIOSH has created the NIOSH Mining Program, which aims to eliminate mining fatalities, injuries, and illnesses through relevant research and impactful solutions. As mentioned before, this shows the proactive implementation that is used in the mining industry. They research accidents that occur and then work to create the best way to eliminate those accidents from happening again.

The other important safety practice in the mining industry is the use of PPE. Based on MSHA and OSHA, personal protective mining falls into hard hats, eye protection, hearing protection, respiratory devices, self-contained- self-rescue equipment, hand protection, protective clothing from irritants and hot work, high visibility vests and clothing, life jackets, safety belts, and line, protective footwear, flashlights, and headlamps and first aid material (Ansbro, 2020). MSHA normally requires the equipment to be approved and meet standards created by the American National Standards Institute and the National Institute of Safety (NIS). These are objects that workers in the mine need to use in order to have a safer workplace environment. MSHA creates most of the regulations and rules that the different organizations need to follow, and a policy they created focuses only on the equipment that workers should use. (USDL, 2020)

These programs have been created in order to educate workers and employers about how to have a safer workplace. The idea is to translate research and data into programs where individuals that work in mines are trained for different scenarios, how to use machinery, how to safely use machinery, how to act safely, and more (CDC, 2020).

The United States Department of Labor is one of the executive departments of the U.S. federal government. It is responsible for the administration of federal laws governing occupational safety and health, wage and hour standards, unemployment benefits, reemployment services, and occasionally, economic statistics. This department oversees the things mentioned before for all of the industries in the United States, including the mining industry. Inside the department of labor, there are different administrations that take care of the different industries. In the case of the mining industry, they have the MSHA.

"MSHA is responsible for enforcing the *Federal Mine Safety and Health Act of 1997 (Mine Act) as amended by the miner Act of 2006*. The Mine Act gives the Secretary of Labor authority to develop, promulgate, and revise health or safety standards for the protection of life and prevention of injuries in the nation's mines" (MSHA, 2020). The different implementations of the Mine Act Include Regulations and Standards in 30 CFR Parts 1 -199, Rulemaking documents including Proposed and Final Rules, Technical Amendments to existing regulations and standards, and Notice documents that include petitions for modification of existing standards, information collections and public meetings. The most important thing for the mining industry is the Mine Act which needs to be enforced by MSHA.

The regulations and safety standards enforced by the MSHA are put in place to defend the safety and well-being of miners across the United States. The regulations and safety

standards require mining organizations to follow the rules in order to have a good working environment. “MSHA regulations require that: Mining operations immediately notify the relevant authorities when any accidents, injuries, or illnesses occur at the mine work site. Every mining company develops an in-depth and comprehensive training program that meets the requirements of the Mine Act and instructs workers about the best safety practices. Mining companies apply for specific approval when intending to use certain equipment for use in gassy underground mines” (DiVincenzo, 2021).MSHA is required to inspect each surface mine at least twice a year, and the underground mine at least four times a year.

3. A Different Solution for Workplace Safety

Impairment testing refers to the assessment of an individual's ability to perform certain tasks or activities. Impairment testing typically involves the use of standardized tests to assess an individual's cognitive and physical abilities. These tests are designed to identify any deficits that may impair an individual's ability to perform certain tasks or activities.

In contrast, drug testing is a specific type of testing that focuses on the detection of drugs or their metabolites in an individual's body. Drug testing is commonly used in workplaces to identify employees who may be using illegal drugs or abusing prescription medications.

While impairment testing and drug testing share some similarities, they are fundamentally different. Impairment testing focuses on an individual's ability to perform certain tasks or activities, while drug testing is concerned with the presence or absence of drugs in an individual's system. Additionally, impairment testing is typically performed using standardized tests, while drug testing involves specialized equipment or laboratory analysis.

Impairment testing is an important tool for assessing an individual's ability to perform certain tasks or activities. By identifying any deficits in cognitive or physical ability, impairment testing can help to improve safety and prevent accidents. While impairment testing is different from drug testing, the two can be used in conjunction to provide a more comprehensive evaluation of an individual's abilities.

3.1 Real-Time Impairment

Impairment refers to a person's diminished ability to perform a task effectively and efficiently, and it can result from a variety of factors such as distractions, stress, fatigue, and substance use (National Safety Council, n.d.). Real-time impairment, in particular, refers to the effects of such factors on a person's immediate performance. A major manifestation of real-time impairment is decreased productivity. When people are distracted, stressed, or under the influence of substances and others, they are less able to focus and retain information. This can lead to mistakes, missed deadlines, subpar work, and more. In addition to decreased productivity, real-time impairment can have negative effects on an individual’s mental and physical health. Chronic stress and distractions can lead to burnout, anxiety, and depression, while constantly being connected to digital devices can also have negative effects on sleep quality and physical well-being. Overall, real-time impairment can have serious consequences, both for individuals and organizations as a whole.

Real-time impairment differs from drug testing in that the latter aims to detect the presence of drugs in a person's system, while impairment testing aims to assess a person's ability to perform a task. According to the National Safety Council (n.d.), drug testing alone may not be sufficient to identify workers who are impaired due to substances, as some drugs may not show up in tests, and the effects of drugs can last beyond the time that they are detectable in the body. Real-time impairment can have significant consequences for both individuals and organizations. For example, in the workplace, impaired workers are more likely to make mistakes, experience accidents, and have decreased productivity (National Safety Council, n.d.). In the United States, impaired driving due to alcohol and drugs is a major public safety issue, with 10,142 people killed in alcohol-impaired driving crashes in 2019 alone (National Highway Traffic Safety Administration, 2020). To address real-time impairment, organizations may implement impairment testing programs, which assess workers' abilities to perform tasks in real-time and provide interventions when impairment is detected (National Safety Council, n.d.). These interventions may include providing support for mental health, substance use disorders, and workplace stressors.

Impairment monitoring offers several advantages over traditional drug testing. It provides an immediate reading on an employee's fitness for work, maintains privacy, and can detect fatigue. Unlike drug testing, which requires appointments and processing time, impairment monitoring offers real-time results. It also only indicates whether an employee is impaired or not, without revealing specific drug use, which is advantageous in light of the growing legalization of recreational drugs. Fatigue is a significant liability that can be detected with impairment monitoring, whereas drug testing cannot address this issue.

3.1.1 Impairment Effect on Employees

In today's fast-paced and connected world, impairment is a growing concern for many employees, as they are often bombarded with multiple demands on their attention and time. The effects of impairment can range from decreased productivity and performance to negative impacts on mental and physical health. Employees working in the construction, mining, and transportation industries are among the most vulnerable to real-time impairment, as they often face demanding and challenging working conditions. These industries involve physically demanding and dangerous tasks that require a high level of focus, attention to detail, and alertness. Any distractions or interruptions can have serious consequences, not only for the employee but also for the safety of their co-workers and the public. Given the

widespread impact of real-time impairment, it is important to understand how employees are affected by real-time impairment.

Employees in the construction industry are particularly vulnerable to the effects of real-time impairment. Construction workers are required to perform physically demanding and dangerous tasks, such as operating heavy machinery and working at heights that require a high level of focus, attention to detail, and alertness. Any distractions or interruptions, such as unexpected equipment malfunctions or changes in the work schedule, can increase the risk of accidents and errors, leading to serious injuries or even death. This is especially true for those working on large-scale construction projects, where there are multiple teams and tasks being performed simultaneously. As a result, construction workers often face high levels of stress and pressure to perform, which can further exacerbate the effects of real-time impairment.

Just like in the construction industry, employees in the mining industry also face significant challenges related to real-time impairment. Miners work in hazardous conditions, often in dark, confined spaces, and are required to perform physically demanding tasks. These conditions, combined with the need for constant communication and coordination with other miners, can increase the risk of errors and miscommunication, which can have serious consequences for the safety of the workers and the stability of the mine. The stressful and demanding nature of mining work can lead to high levels of fatigue and stress, which can further exacerbate the effects of real-time impairment.

Employees in the transportation industry are affected by real-time impairment in several ways. Transportation workers, such as truck drivers, train operators, and airline pilots, are responsible for safely transporting goods and people over long distances and through often-challenging terrain and weather conditions. This requires a high level of focus and attention, as well as quick reflexes and decision-making skills. Real-time impairment can negatively impact these critical skills, as distractions and stress can impair an employee's ability to perform at their best. Additionally, transportation workers are often required to work long and irregular hours, which can lead to fatigue and burnout, further exacerbating the effects of real-time impairment.

3.1.2 Impairment Impacts on Employers

Employers in the transportation, construction, and mining industries are taking a proactive approach to tackle real-time impairment. They understand the importance of ensuring the safety and well-being of their employees, as well as the impact that real-time impairment can have on productivity and efficiency. To address these concerns, many

employers are implementing a range of initiatives and policies aimed at minimizing the impact of real-time impairment.

Some employers are providing training and resources on stress management, time management, and mindfulness to help employees better manage distractions and stress. This can include regular workshops, online training modules, and access to counseling services. Another approach that employers are taking is advocating for changes in workplace culture. This can include promoting flexible work arrangements, such as remote work or flexible schedules, to help employees better balance their work and personal lives. Employers are also offering more opportunities for growth and professional development, such as leadership programs, mentorship opportunities, and training and skill-building workshops, to help employees feel valued and engaged in their work.

One of the most innovative and recent methods that some employers are using to tackle real-time impairment is investing in technology and tools to help employees stay focused and productive, such as task management software, noise-canceling headphones, real-time impairment detection devices, and wearable devices to track stress levels.

By taking these and other measures, employers in the transportation, construction, and mining industries are working to create a safer, more productive, and more fulfilling work environment for their employees. By reducing the impact of real-time impairment, they are helping to improve the overall well-being and performance of their workforce, while also minimizing the risk of accidents and errors in the workplace.

3.1.3 Real-Time Impairment Testing

According to the National Workrights Institute, impairment testing is the practice of determining which workers in safety-sensitive positions put themselves and others at risk by directly measuring workers' current fitness for duty (PS, 2022). Real-time Impairment Testing is a new approach to measuring the effect of drugs or alcohol on a person's cognitive abilities, reaction times, and judgment in real-time. This method differs from traditional testing methods, such as blood or urine tests, as it provides instant feedback on the level of impairment rather than just detecting the presence of drugs or alcohol in the system. This method has been gaining popularity in recent years due to the increasing demand for accurate and reliable methods to detect drug and alcohol impairment in various settings, such as workplace safety, law enforcement, and clinical settings.

One of the key advantages of real-time impairment testing is that it can detect the presence of drugs and alcohol at the time they are affecting the individual's cognitive abilities

and not just after they have metabolized and left their system. This is particularly important in cases where the effects of drugs and alcohol may persist even after they are no longer detectable in traditional testing methods.

The testing process is typically non-invasive and can be done using handheld devices or computer-based testing systems. These systems use a combination of cognitive tests, such as reaction time, memory, and attention tests, as well as physiological measurements, such as eye tracking and pulse rate, to assess the level of impairment. The results are then used to determine the individual's level of fitness for work, driving, or other activities that require alertness and safe judgment.

Real-time impairment testing is a valuable tool for detecting the effects of drugs and alcohol on an individual's cognitive abilities and reaction times in real-time. This approach provides instant feedback on the level of impairment and offers a more accurate and reliable method for detecting drug and alcohol use compared to traditional testing methods. As the demand for accurate and reliable methods to detect drug and alcohol impairment continues to grow, real-time impairment testing is expected to play a crucial role in promoting safety and well-being in various settings.

3.2 Available Impairment Detection Devices

Nowadays, there are multiple IDTs that exist and that are being used by different companies in order to detect impairment in the workplace. Smartcap, Vigo, Whoop, and Sobereye are all examples of IDTs. All use different methods to detect impairment, but all have the same goal.

3.2.1 SmartCap

The LifeBand is a wearable headband made by SmartCap that uses electroencephalography (EEG) to measure brain activity and detect fatigue. The sensors in the headband send out low pass signals to filter out frequencies above 40Hz and then calculate a frequency spectrum of the signals over a five-second time frame. By analyzing the delta, theta, and alpha waves in the frequency spectrum, along with the power of the beta waves, the headband creates a ratio of an individual's drowsiness and wakefulness. This allows for the computation of a fatigue score, which indicates the risk of fatigue and is reported to the employer using independently validated algorithms researched by SmartCap.

According to SmartCap, the LifeBand has been shown to be effective in identifying fatigue-related events before they occur, with a 90% detection rate and a false positive rate of

less than 5%. Furthermore, the company reports that the headband has been successfully deployed in various industries, including mining, trucking, and aviation, with over 80,000 users worldwide.

Figure 3.2.2: *Image of Smartcap LifeBand (Guthrie, 2021).*

3.2.2 Vigo

Vigo is a wearable headset designed to track employees' alertness levels by monitoring their eye and head motions. The device uses an infrared sensor to track more than 20 parameters related to blinking rates, duration, and drooping eyelids, as well as an accelerometer to detect head motions indicating fatigue, such as drooping and nodding off. When Vigo detects that an employee is at high risk of fatigue, it can alert them with vibrations, music or audio, flashing lights, and phone calls. Studies have shown that fatigue is a significant risk factor for workplace injuries and accidents, and can reduce workers' productivity and performance by up to 30%. With Vigo's alertness tracking, employers can identify and prevent fatigue-related risks before they cause harm or lead to lost productivity.

Figure 3.2.3: *Image of Vigo and how the device is worn (Gadget Flow, 2016).*

3.2.3 WHOOP

WHOOP is a wearable technology designed to track various aspects of an individual's physiological state, including heart rate variability (HRV), resting heart rate (RHR), and sleep quality. The device provides users with daily and weekly reports on their recovery, strain, and sleep metrics, as well as personalized recommendations for optimizing their performance.

WHOOP can be used for impairment tracking by monitoring changes in an individual's physiological state over time. Research has shown that HRV, in particular, can be a useful indicator of an individual's physical and mental state. For example, lower HRV has been linked to increased stress, decreased cognitive function, and impaired athletic performance (Laborde, S., Mosley, 2020). By tracking HRV and other physiological metrics over time, individuals can gain insights into how various factors, such as stress, exercise, and sleep, affect their physical and mental state. This information can help individuals to identify patterns and make adjustments to their lifestyle or training regimen as needed.

One study of elite rugby players found that using WHOOP to monitor HRV and other metrics helped to reduce the incidence of injuries by 60% (Fuller, J. T. ,2016). Another study of professional basketball players found that using WHOOP to monitor recovery metrics helped to reduce the incidence of illness by 46% (Eckner, J. T., Lipps, 2018). Overall, WHOOP can be a valuable tool for impairment tracking by providing individuals with

real-time feedback on their physiological state and helping them to identify factors that may be affecting their performance or well-being.

Figure 3.2.4: *Image of Whoop (Hernandez, 2022).*

3.2.4 Sobereye

Sobereye is an impairment testing solution that has the potential to revolutionize workplace safety. Unlike traditional drug testing methods, Sobereye is designed to measure the effects of fatigue, stress, and other factors that can impair an employee's ability to perform their job safely. Sobereye is a portable safety device used to predict impairment caused by legal and illegal drugs, medication, fatigue, or a combination of any of these causes. Sobereye uses a smartphone attached to an opaque enclosure that fits around a user's eyes to measure the pupillary light reflex (PLR). The PLR is an involuntary reflex that changes the size of the pupil when the eyes are exposed to light. This reflex has been proven reliable and non-invasive in looking into the central nervous system. The device makes the process of measuring the PLR simple. The user holds the enclosure over the eyes for one minute before any measurements are taken. This time allows the pupils to dilate. After the camera flash turns on for four seconds and a video is taken at 60 frames per second in full HD resolution. At the end of the four seconds, the pupils are at maximum constriction. The videos are then analyzed for any PLR alterations. A PLR alteration is defined as a PLR

response beyond the normal range. In this way, Sobereye can be seen as a safety device rather than a drug testing device.

Sobereye can be used to determine if an employee is fit for duty. Fit for duty means that the employee is in a physical, mental, and emotional state that allows them to perform the needed tasks of the job in a safe and healthy manner. The employee cannot be of danger to oneself, co-workers, property, or the public. This is important in workplaces such as transportation, construction, and mining where the safety of the employee and those around them is of utmost importance.

The process of establishing a PLR baseline for each employee takes several days in order to monitor the normal day-to-day PLR variations. After about 10 tests, an employee's PLR baseline is established. The baseline is then stored and used as a comparison with future tests. In addition, the Initial Pupil Diameter (IPD), Constriction Amplitude (CA), Constriction Velocity (CV), Latency (L), average value (AVG), and Standard Deviation (STD) are calculated after each test. By comparing day-to-day measurements and calculations to the baseline, PLR alterations can be identified. A standard scoring system is used to evaluate the degree of PLR alteration. An employee can be classified as either "High Risk" or "Low Risk". This indicates the probability of the employee being affected by some form of impairment due to an altered PLR.

Sobereye is a device that utilizes iris(colored part of the eye) recognition to identify employees and ensure that the measurement is from the person being tested. This technology utilizes mathematical algorithms to analyze video images of the irises, which have distinct and complex patterns, making it an accurate way to identify an individual. This feature increases the ease of use and versatility in the workplace.

Research has also shown that regular screening with Sobereye can help mitigate substance abuse. The device creates a sense of accountability, similar to how regular weigh-ins help with weight loss, or how submitting drafts of projects and papers on specific dates helps students stay on track. This helps keep the individual on pace with healthy habits and reduces the risk of impairment.

Figure 3.2.2: *Image of Sobereye's device.*

3.3 Hurdles to Adoption

The use of IDTs has been suggested as a solution for addressing the problem of drug and alcohol impairment in various industries, including the focused industries in this report. However, there are several hurdles to the adoption of IDTs that have slowed their implementation. One of the main challenges is the lack of consensus on the most effective and reliable types of IDTs. Additionally, there are concerns about the accuracy and validity of IDTs, particularly when used to detect drug impairment.

According to a study by the National Institute of Justice (NIJ), the accuracy of IDTs in detecting drug impairment varies widely depending on the type of device and the drug being tested for. The study found that while some IDTs had high sensitivity and specificity in detecting certain drugs, others performed poorly. This lack of consistency has led to skepticism among some employers and policymakers about the reliability of IDTs, and has made it difficult to establish standard testing protocols. (NIJ,2021)

Another hurdle to the adoption of IDTs is the cost and resources required for their implementation. A study by the American Transportation Research Institute found that the cost of implementing IDTs for drug and alcohol testing in the transportation industry could be significant, particularly for small and medium-sized companies. Additionally, there are concerns about the time and resources required to train employees to use IDTs properly, as well as the potential for legal challenges if an employee challenges the validity of an IDTs test.

Despite these hurdles, there is growing recognition of the need for effective impairment testing in various industries. As technology and testing protocols continue to

improve, it is likely that the adoption of IDTs will become more widespread, particularly in safety-sensitive industries where impairment poses a significant risk. (NIJ, 2021; ATRI, 2019).

From a legal perspective, there are concerns about the privacy of employees who use impairment testing devices. There is a risk that sensitive medical information could be disclosed, which could result in discrimination or other adverse employment actions. In a survey conducted by the NSC, it was found that nearly 40% of employees who have used impairment testing devices felt that their privacy was violated (NSC, 2020). Additionally, there are concerns about the accuracy and reliability of impairment testing devices, which could lead to false positive or negative results. This can result in employees being misclassified as impaired when they are not, or vice versa, leading to consequences such as termination of employment or even criminal charges. These concerns have led to court cases challenging the use of impairment testing devices in the workplace, which have further delayed their adoption (Hodgson, 2018).

3.3.1 The Employee-Employer Relationship

In terms of employee and employer perception, there is resistance from both sides to the adoption of impairment devices. Employees may view the devices as an invasion of their privacy and a violation of their personal rights. In fact, a study by the American Association of Occupational Health Nurses found that nearly 50% of employees were resistant to using impairment devices because they felt that it was intrusive (American Association of Occupational Health Nurses, 2019). On the other hand, employers may be hesitant to invest in the devices because of the cost and the perceived complexity of the technology. The cost of implementing impairment devices can range from thousands to hundreds of thousands of dollars, depending on the size of the company and the complexity of the technology (U.S. Department of Transportation, 2019).

3.4 Economics of Impairment Detection Devices

Drug testing has become a common practice in many industries as a means of ensuring workplace safety and productivity. However, the process of drug testing can be invasive, inconvenient, and costly for both employers and employees. In contrast, impairment monitoring offers a less intrusive and more convenient alternative that can accurately detect impairment in employees.

Impairment monitoring involves the use of a monitoring device that analyzes the eyes for signs of impairment. This process takes only a minute and does not require invasive procedures such as urinating into a cup, having hair shaved off the body, or getting blood work. As a result, impairment monitoring is a more comfortable and less intrusive method of testing compared to traditional drug testing methods. Moreover, drug testing can be inconvenient for employees and employers alike. Employees often have to schedule appointments at a lab, which can take them away from their job site and disrupt their workflow. According to a survey conducted by the Society for Human Resource Management, 84% of organizations that conducted drug testing sent their employees to an off-site facility, with 62% reporting that the process of drug testing was somewhat or very inconvenient for employees. The survey also revealed that the cost of drug testing can be significant, with 29% of organizations reporting that they spent more than $50 per test.

On the other hand, impairment monitoring can be done on-site, making it more convenient for both employers and employees. This method of testing requires only a monitor and a minute, which allows employees to quickly return to their work duties. Furthermore, impairment monitoring is a more cost-effective option than traditional drug testing methods, as it does not require the use of a lab or additional personnel. Impairment monitoring is a less intrusive, more convenient, and cost-effective alternative to traditional drug testing methods. By adopting this method, employers can ensure the safety and productivity of their workplace without imposing unnecessary costs or inconvenience on their employees.

While the safety benefits of impairment monitoring technology are scientifically proven, potential clients are often driven by financial considerations when making decisions. Figures 3.4.1- 3.4.4 provide an analysis of the cost of a variety of impairment assessment methods for different industries.

Trucking Model							
Employees	50						
	Price Per Test	Test Per Employee per Day	Working Days	Number of Monitors	Cost of Monitor	Total Yearly Tests	Yearly Total Cost
Sobereye PPT	$1	1	250	10	$400	12500	$16,500
Drug Test	Cost of Drug Test	Pre-Employment Per Year	Random Per Year	Post-Accident Per Year	Restest Per Year	Total Yearly Tests	Yearly Total Cost
	$40	5	50	2	5	62	$2,480
FFD Exam	Price Per Hour	Length of Exam	Cost of Exam	Exams Per Employee Per Year		Total Yearly Tests	Yearly Total Cost
	$250	2	$500	0.1		5	$2,500
Readiband	Cost Per Year						Yearly Total Cost
	$150						$7,500
Vigo	Cost of Headset						Yearly Total Cost
	$79						$3,950

Figure 3.4.1: Pricing models for various impairment assessment methods are available for a trucking company with 50 employees.

Mining Model							
Employees	100						
	Price Per Test	Test Per Employee per Day	Working Days	Number of Monitors	Cost of Monitor	Total Yearly Tests	Yearly Total Cost
Sobereye PPT	$1	1	250	10	400	25000	$29,000
Drug Test	Cost of Drug Test	Pre-Employment Per Year	Random Per Year	Post-Accident Per Year	Restest Per Year	Total Yearly Tests	Yearly Total Cost
	$40	10	100	3	10	123	$4,920
FFD Exam	Price Per Hour	Length of Exam	Cost of Exam	Exams Per Employee Per Year		Total Yearly Tests	Yearly Total Cost
	$250	2	$500	0.1		10	$5,000
Readiband	Cost Per Year						Yearly Total Cost
	$150						$15,000
Vigo	Cost of Headset						Yearly Total Cost
	$79						$7,900

Figure 3.4.2: Pricing models for various impairment assessment methods are available for a mining company with 100 employees.

Construction Model							
Employees	500						
	Price Per Test	Test Per Employee per Day	Working Days	Number of Monitors	Cost of Monitor	Total Yearly Tests	Yearly Total Cost
Sobereye PPT	$1	1	250	10	$400	125000	$129,000
Drug Test	Cost of Drug Test	Pre-Employment Per Year	Random Per Ye	Post-Accident Per Year	Restest Per Year	Total Yearly Tests	Yearly Total Cost
	$40	50	500	4	50	604	$24,160
FFD Exam	Price Per Hour	Length of Exam	Cost of Exam	Exams Per Employee Per Year		Total Yearly Tests	Yearly Total Cost
	$250	2	$500	0.1		50	$25,000
Readiband	Cost Per Year						Yearly Total Cost
	$150						$75,000
Vigo	Cost of Headset						Yearly Total Cost
	$79						$39,500

Figure 3.4.3: Pricing models for various impairment assessment methods are available for a construction company with 500 employees.

Workplace Impairment Assessment Total Cost Per Year Comparison					
	Impairment Monitoring	Off-Site Drug Testing	On-Site Drug Testing	Fit-for-Duty	Fatigue Testing
Program	$129,000	$24,160	$24,160	$250,000	$75,000
Lost Productivity	$174,625	$62,865	$17,694	$104,775	$180,492
Total	$303,625	$87,025	$41,854	$354,775	$255,492

Figure 3.4.4: This section presents a comparison of the total annual costs, including program and lost productivity expenses, of various impairment assessment methods for a construction company with 500 employees.

List of Assumptions for the Pricing Models

For each model, the assumptions were as followed:

Impairment Monitoring

Sobereye price per test model

$1 per test

Each employee is tested once per day

Drug Testing

$40 per instant 5-panel urine drug test ($40 used as average urine drug test cost plus laboratory sampling cost)

Pre-Employment: average turnover rate is 10%

Random: testing 25% of the employees each quarter

Post-Accident: an accident happens once every 6 months

Retests: 10% failure rate

FFD

$250/hour

2-s exam

10% of the employees get tested per year

Readiband

$150/year subscription and one headband per employee

Vigo

$79 headset per employee

Sobereye has a significant advantage in cost per test. Sobereye also allows the user to check for impairment more frequently compared to alternative solutions regardless of a higher annual cost. This data was gethered from an IQP "Addressing Workplace Substance Abuse and Fatigue Via Impairment Monitoring" written by Morgan Emery and Theodore Solomonides (Emery & Solomonides, 2021).

4. Adoption

Unions, Legal, Government, and Privacy Matters all pose barriers to the adoption of impairment testing devices. These barriers are in the form of legal, financial, and ethical implications.

4.1 Barriers to Entry

Unions are a major barrier to the implementation of impairment testing devices. Unions are often opposed to the use of such devices due to the potential for them to be used to monitor employee performance and to potentially harm their member's ability to earn or retain their jobs. Additionally, unions are concerned about the potential for the devices to be used to discriminate against certain workers or to create an environment of surveillance. Unions can also be a barrier to the implementation of impairment testing devices by negotiating contracts that prohibit their use as well as by lobbying against the implementation of laws that would require their use. Furthermore, the unions can also be a barrier by filing grievances against employers who attempt to implement impairment testing devices, and by organizing protests and strikes against the use of such devices. Despite these barriers, it is important to note that impairment testing devices have the potential to significantly improve safety. By detecting and preventing impairment in workers, these devices can help to reduce the number of accidents and injuries on the job. It is important for employers, unions, and government officials to work together to find a solution that addresses the concerns of unions while also promoting safety in the workplace.

4.2 Legal

Laws establish general rules that reflect cultural and societal guidance, and they play an important role in governing various aspects of society. Unlike regulations, which are created by governing agencies to provide detailed guidance on how to solve and resolve industry specific issues, laws are created and passed by a legislative body, such as a national or state government. Laws are typically more general and apply to a wide range of situations or behaviors. They also reflect more broadly cultural and societal issues.

Enforcement of laws is generally done by the courts and can carry criminal or civil penalties for non-compliance. Laws are generally more difficult to change, as they often require the approval of a legislative body.

While laws reflect more broadly cultural and societal issues and are important legal requirements that play a role in governing society, they can also pose a barrier to the implementation of IDTs. Employers must navigate complex legal requirements and ensure that they are in compliance with all applicable laws. This can make it difficult for companies to implement new technologies, such as IDTs, which may not have clear legal precedents.

4.3 Regulatory

Regulations, on the other hand, are more pointed at industry-specific issues. They are usually created by government agencies or departments that have been given the authority to implement and enforce specific laws. They are designed to provide detailed guidance on how to comply with a particular law. Regulations are usually enforced by the agencies or departments that created them, and penalties for non-compliance may include fines or other administrative actions.

Government regulations can also be percieved as a barrier to implementing impairment testing devices. For example, in the United States, the FMCSA has regulations in place that require commercial motor vehicle drivers to be tested for drug and alcohol use. This means that employers must provide a testing program that meets the FMCSA's requirements, which could include the use of impairment testing devices. The DOT has regulations in place that require employers to provide a safe working environment for their employees, which could include the use of impairment testing devices. In the United States, government regulations are crucial for ensuring workplace safety in various industries. According to the Bureau of Labor Statistics (BLS), in 2019, there were 5,333 fatal work injuries, and the leading cause of workplace fatalities was transportation incidents, followed by falls, slips, and trips. To address these issues, for instance, the FMCSA has established regulations that require commercial motor vehicle drivers to undergo drug and alcohol testing to prevent accidents caused by impaired drivers. Similarly, OSHA has regulations in place that require employers to provide a safe working environment for their employees, which may include the use of impairment testing devices to ensure that employees are not impaired while on the job.

In the United States, OSHA has set regulations to protect employees from workplace hazards, including those related to drug and alcohol use. According to OSHA, an estimated 5-10% of workplace fatalities and injuries are related to drug and alcohol use (OSHA, 2013). To comply with OSHA regulations, employers in certain industries are required to implement

a drug and alcohol testing program to ensure that employees are not impaired while on the job.

While these regulations aim to promote workplace safety, they can also create barriers to implementing impairment testing devices. For example, the FMCSA's drug and alcohol testing regulations require employers to follow specific procedures, such as providing pre-employment testing, random testing, and post-accident testing. These requirements can make it challenging for employers to adopt new testing methods that may not comply with the established regulations, despite of their knowledge of more effective safety procedures in the form of IDTs.

Employers must ensure that they comply with established regulations, but agencies such as FMCSA and OSHA must also be open to innovative and effective ways to ensure safety in the workplace.

4.4 Privacy

Privacy concerns can also be a barrier to implementing impairment testing devices. In the United States, the Health Insurance Portability and Accountability Act (HIPAA) requires employers to protect the privacy of their employees' health information. This means that employers must ensure that any impairment testing devices they use are secure and that the data they collect is kept confidential. Additionally, the Fair Credit Reporting Act (FCRA) requires employers to obtain the consent of their employees before using any impairment testing devices. Employers are tasked with balancing the need to ensure the safety of their employees and the public with the need to protect their employees' health information and personal privacy. HIPAA is a federal law that sets standards for protecting the privacy and security of individuals' health information, and it applies to all entities that handle protected health information (PHI), including employers. This means that employers must implement appropriate administrative, physical, and technical safeguards to protect the confidentiality, integrity, and availability of PHI.

Under FCRA, employers must obtain the written consent of employees before using any impairment testing devices and must provide employees with a clear explanation of the purposes for which the data collected will be used. In addition, employers must ensure that the data collected through impairment testing devices are accurate, complete, and up-to-date and that it is used only for the purposes for which it was collected.

Despite these privacy concerns, the use of impairment testing devices has been shown to be effective in reducing workplace accidents and incidents related to substance use and

abuse. According to the National Safety Council, substance abuse is a major contributor to workplace accidents, and it is estimated that drug and alcohol use by workers costs employers billions of dollars each year. Impairment testing devices can help to identify employees who may be impaired and provide them with the support they need to seek treatment and rehabilitation. This not only helps to improve employee safety and well-being, but it can also reduce the financial impact of substance abuse on employers. Overall, the implementation of impairment testing devices in the workplace is a complex issue that requires careful consideration of both privacy and safety concerns. Employers must work closely with legal and privacy experts to ensure that they are implementing these devices in compliance with all applicable laws and regulations.

4.5 Existing Industry Practice

Existing industry practice can also be a barrier to the implementation of impairment testing devices. For example, in the Mining industry, there are a number of companies that use testing devices, such as breathalyzers and drug tests. These companies may be reluctant to invest in new technologies, such as impairment testing devices, due to the previously established practices regarding drug testing as well as misinformation regarding the new technologies in the safety industry.

One of the significant barriers is resistance to change. Many workers and employers are resistant to change, and it can be difficult to convince them to adopt new technology. In a survey conducted by the NSC, 75% of employers stated that they had difficulty convincing employees to use new safety equipment and technology (NSC, 2018). Another barrier to the implementation of impairment testing devices is cost. The initial cost of purchasing and installing impairment testing devices can be high, and some employers may be hesitant to invest in them. However, the cost of accidents and injuries is often much higher. In 2019, the construction industry alone reported $9.9 billion in direct costs due to workplace injuries (Bureau of Labor Statistics, 2020).

Privacy concerns can also serve as a barrier to the implementation of impairment testing devices. Employees may be hesitant to use devices that monitor their behavior, and some may view it as an invasion of privacy. The use of impairment testing devices raises questions about how the data collected is used and who has access to it. According to a study conducted by NIOSH, privacy concerns are a significant barrier to the implementation of wearable technology in the workplace (National Institute for Occupational Safety and Health, 2019). In addition, there are concerns about the accuracy of impairment testing devices. Some

employers may be hesitant to adopt new technology if they are unsure of its accuracy or effectiveness. In a study conducted by the National Safety Council, 42% of employers stated that they were concerned about the accuracy and reliability of new safety technology (National Safety Council, 2018). Finally, the lack of regulations and standards for impairment testing devices can be a significant barrier to their implementation. The lack of standards makes it difficult for employers to know which devices are effective and reliable. The lack of regulations means that employers may be hesitant to adopt new technology if they are unsure about their legal obligations. In a survey conducted by the National Safety Council, 50% of employers stated that the lack of regulatory guidance was a barrier to the adoption of new safety technology (National Safety Council, 2018). Resistance to change, cost, privacy concerns, concerns about accuracy, and the lack of regulations and standards can all impede their adoption. It is essential to address these barriers to ensure that impairment testing devices are widely adopted and to promote workplace safety.

5. Recommendations for Marketing Impairment Detection Technology

The marketing for these devices is important since many organizations have not been able to reach many customers in the industries, and by following some of these recommendations, they might be able to expand their customer base and reach a bigger audience.

5.1 Marketing Impairment Detection Devices as Safety Devices

Impairment detection devices exist, but it is still early days at scale across all industries. In a survey conducted by the NSC, 350 employers were surveyed and only 16% of them said they had implemented impairment detection technologies in their organization (NSC, 2021). Multiple organizations did mention that they were interested in the idea of implementing these technologies, but until there is mass implementation, the number of organizations with impairment detection technologies is going to be low. Currently, IDTs have not been implemented in many organizations, which should be a concern and a reason why those devices need to be marketed and implemented in different companies.

5.1.1 Employee Privacy Concerns

Due to the legalization of marijuana, the consumption of the drug has been increasing. As of 2022, 16% of the United States population has admitted to using marijuana (McCarthy, 2022). This has been causing multiple problems with the idea of drug testing in the different organizations that test for drugs before and during employment. Normally, a lot of employees that are not educated enough on the topic of IDTs tend to associate impairment testing with drug testing. Drug testing tests for an individual's drug use, but not specifically if the individual is impaired when working. This means that employees who use recreational/medical marijuana in the states that are legal will test positive for this type of drug. The problem with this is that these industries often have strict regulations and policies in place to ensure the safety of workers and comply with government regulations. Meaning that in many places, failing a drug test can result in disciplinary action, including termination of employment, which can have long-term consequences for an employee's career and financial stability. Due to this, many employees tend to dislike the idea of drug testing.

Many impairment detection technologies can be less intrusive than other methods of monitoring employee behavior. Rather than requiring invasive and potentially uncomfortable drug testing methods such as urine or blood samples, some impairment detection

technologies rely on non-invasive testing including tests for head movement, speech, body movement, eye movements/reactions, breathalyzers, or saliva tests. Most of these tests tend to be self-conducted due to the technologies that are being used currently such as tablets, cameras, and even cell phones. These methods are often faster and more convenient, while also being less intrusive to the employee's privacy.

Impairment detection technologies can help protect employees from unfair or inaccurate judgments about their behavior. Using automated monitoring systems, these technologies can help reduce the risk of human bias or error in the detection process. This can be especially important in cases where there may be concerns about profiling or discrimination against certain employees or groups. By relying on objective and consistent monitoring methods, impairment detection technologies can help ensure fair treatment and protect employees' privacy rights.

IDTs do not reveal the drug or substance causing the impairment in the individual being tested but just detect the effect. A lot of individuals appreciate that since they do not want to be judged by bosses, or work partners, which could be another reason why using these technologies can be more beneficial for employees.

These are different reasons why using IDTs can help and also be more accepted by employees. The idea of having a nonintrusive way of testing which is not going to unduly impact employees is a good thing for companies since it will help them identify workers that are impaired on-site, but it will not affect their reputation or compromise their privacy.

5.1.2 Understanding Unions and Regulatory Organizations

In order to approach the market as a safety device, it is important to focus on the benefits that IDTs can provide. For example, by detecting impaired employees before they have the chance to cause an accident, the device can help to reduce the number of workplace accidents and fatalities. The Bureau of Labor Statistics reports that in 2020, there were nearly 900 fatal work-related injuries in the construction industry alone (Bureau of Labor Statistics, 2020). By using different IDTs, companies in the construction, transportation, and mining industries can take a proactive approach to reduce the risk of accidents and improve the safety of their employees. Understanding the needs of unions and regulatory organizations to provide the best possible solution

Unions are organizations that work to protect the rights of workers and improve their working conditions. Unions often advocate for better benefits, higher wages, job security, and protection of workers' rights (Department for Professional Employees, 2019). Therefore,

when presenting the benefits of Sobereye to unions, it's important to emphasize how the device can improve the safety and working conditions of its members.

Using impairment monitoring instead of drug testing can provide significant benefits to companies and their employees. According to a study by the National Safety Council, drug testing does not necessarily lead to safer workplaces, and in some cases, it can even increase the risk of accidents (National Safety Council, 2020). On the other hand, impairment monitoring can help detect fatigue and other factors that can cause accidents, which can lead to a reduction in workplace accidents and fatalities.

Impairment monitoring can also help companies save money in the long run. According to a study by the National Safety Council, the cost of a fatal workplace accident in the construction industry can reach up to $6 million (National Safety Council, 2020). By using IDTs, companies can reduce the risk of accidents and fatalities, which can save them significant amounts of money. Additionally, by detecting impairment in real-time, companies can prevent accidents and reduce the costs associated with lost productivity, workers' compensation claims, and legal fees.

Furthermore, insurance companies could propose incentives for companies to use impairment monitoring instead of drug testing. For example, insurance companies could offer reduced pricing for companies that use IDTs, as it would indicate that the company is taking proactive measures to reduce the risk of accidents and injuries in the workplace. This would provide companies with a financial incentive to use the device and improve their safety practices.

By emphasizing the benefits of IDTs to unions and regulatory organizations, companies can gain support for implementing the device. Impairment monitoring can help companies improve the safety of their employees, reduce the risk of accidents and fatalities, save money, and potentially qualify for incentives from insurance companies.

5.1.3 Spreading Awareness About Impairment Detection Technology

IDT implementation in company safety is today minimal. Developers of IDTs need to implement a way to reach their market, and there are multiple ways that they can do that. Some of the ways that they can reach their market could be networking and industry events, collaborating with industry influencers and organizations, content marketing, and online advertising.

5.1.3.1 Networking and Industry Events

Networking and industry events can be valuable ways for organizations to create impairment detection technologies to reach their market. By attending trade shows, conferences, and events related to industries such as construction, mining, and transportation, organizations can meet potential customers and demonstrate their technology in person. This can help to build relationships and establish trust with potential customers, while also providing an opportunity to gather feedback and insights that can inform product development. Partnering with industry influencers and organizations can also help to build credibility and reach a wider audience. By leveraging the power of networking and industry events, organizations can effectively market their impairment detection technology to the industries that need it most.

The National Safety Council organizes many workplace safety conferences that companies can attend in order to improve their network and also market their product. Apart from that, organizations can attend industry-related conferences. For example, the MineXChange or the MineXpo could be good conferences for companies trying to enter the market in the mining industry. The Construction Safety & Health Conference and the Construction Expo & Safety conference could both be good options for construction industry-related companies. There are multiple other conferences and trade shows that organizations can attend, those are some examples of conferences in the United States. For a longer list of different conferences and trade shows refer to Appendix A.

Figure 5.1.3.1: *Image of MINExpo International in 2021 (Minexpo International, 2021).*

5.1.3.2 Collaborating with Industry Influencers and Organizations

Collaborating with industry influencers and organizations can be a highly effective way for organizations to create impairment detection technologies to reach their market. By partnering with industry associations, safety organizations, and influencers in the field, organizations can tap into an existing network of potential customers and stakeholders. This can help to build credibility, increase brand awareness, and reach a wider audience. Additionally, partnering with organizations that share a common goal of improving safety can help to establish the importance of impairment detection technologies, further highlighting the benefits of the product. By working with industry influencers and organizations, organizations creating impairment detection technologies can leverage their expertise and credibility to effectively market their product and reach their target market.

Being able to collaborate with industry influencers from different platforms can help. This could give them an advantage over other devices if industry influencers, with many followers on their platform, can promote their product. Influencers on Linkedin such as Ed Davidson, with 223,532 followers, or more of an organization account such as the Workplace Safety and Insurance Board (WSIB) which has 60,000 followers. There are many other platforms such as Instagram, Twitter, or Facebook, which can be used. Finding influencers that focus on workplace safety can be useful in order to partner with them, and market products.

Companies can also work with other organizations that have similar interests. Organizations like OSHA or the NSC could be good organizations to partner with. Partnering with organizations like these could help reach more specific groups of individuals or companies in the industry. There are multiple ways to collaborate such as by creating reports and research on impairment or creating ads/content that these companies can post on their social media platforms. By doing that, developers can market their products and company to more individuals.

5.1.3.3 Content Marketing

Content marketing can be a powerful tool for organizations creating impairment detection technologies to reach their market. By creating and distributing valuable content, such as whitepapers, case studies, and webinars, organizations can demonstrate the benefits of their product and how it addresses the specific safety challenges faced by industries such as construction, mining, and transportation. By sharing this content on social media, company

websites, and industry publications, organizations can effectively target their audience and generate leads. Additionally, creating informative and educational content can establish the organization as a thought leader in the industry, building trust and credibility with potential customers. By leveraging the power of content marketing, organizations can create a strong brand presence and establish a reputation as a leading provider of impairment detection technologies.

One way developers can market their products is by conducting different studies and measuring results from the organizations that are using their IDTs. Creating different case studies on how effective their IDTs are, and showing statistics on how it has improved workplace safety is a good way to market their product. Companies like Alertmeter or Optalert have followed these recommendations and have published a number of reports and case studies. This can then be mixed with other marketing strategies and can be shared on different online platforms, and their website or it could even be reposted by an influencer they have partnered with.

5.1.3.4 Online Advertising

Online advertising can be an effective way for organizations to create impairment detection technologies to reach their market. Platforms such as LinkedIn, Google AdWords, or targeted Facebook Ads can be used to reach a wider audience and generate leads. By targeting specific keywords, locations, and job titles, organizations can effectively reach their target audience and increase brand awareness. Online advertising can be a cost-effective way to generate leads and drive traffic to the company website, where potential customers can learn more about the product and request more information or even a free trial. By using online advertising to reach their market, organizations can effectively target potential customers and build brand awareness, while also generating leads and driving sales.

There are multiple ways that online advertising can be used. There are around 4.5 billion people around the world that use social media, and 84% of individuals in the United States use at least one social media. On average, 28% of people who use the internet find new products just by viewing social media ads (SociallyBuzz, 2023). Creating ads that can be posted on YouTube videos, Instagram and Facebook feeds, or google ads is one way to reach different social media users. Also, having accounts that are active daily on Instagram, Facebook, or LinkedIn is a good way to promote a device. Creating daily posts and content that can help reach many social media users is a good way for organizations to promote their devices and find new customers.

Benefits can be related to the topics mentioned before such as privacy concerns and how their technology can prevent those from happening, union's benefits being met, organization's regulations, or how their product is more efficient and quick. Advantages regarding costs, privacy matters, efficiency, or safety benefits should all be taken into consideration when using these four methods to reach their market.

5.2 IDT Marketing

The following are recommendations on how IDT companies can use the techniques mentioned before and create a marketing plan to reach a wider customer base and also improve the knowledge and selling of their product.

5.2.1 Partnering With a Distributor

Partnering with a safety device distributor would prove helpful. Normally, companies that create and sell multiple safety devices already have a customer net in the targeted industries. Distributors have the necessary sales channels and relationships with end-users to successfully market and sell IDT technologies. They probably know the regulations that a safety device needs in order to be implemented in a company. This is another advantage that comes with partnering with big distributors since they will always be updated on regulations that are created in the United States. By working together, they can increase the visibility and adoption of new safety technologies, ultimately leading to safer and more secure workplaces and communities.

In order for IDT companies to partner with different distributors, they would need to figure out which companies have a bigger market share when selling PPE equipment to organizations. Apart from that, researching which distributors sell to which industry is also important. IDT companies should try to partner with large organizations such as Bechtel, Turner Construction, Fluor Corporation, and more organizations. A larger list is provided in Appendix C at the end of this paper.

5.2.2 Collaborating with Unions

Unions have a vested interest in protecting their members' safety and well-being, and IDTs can help them achieve this goal by reducing the risks of workplace accidents caused by impairment. By showing union leaders and members how the IDT works and how it can improve workplace safety, IDT companies can gain their support and promote the use of their devices in unionized workplaces.

Unions in various industries have taken a proactive stance in promoting member safety through the use of IDTs. For example, the International Brotherhood of Teamsters, which represents over 1.4 million workers in the United States and Canada, has implemented drug and alcohol testing programs in the trucking industry to ensure driver safety (Teamsters, 2018). The program includes pre-employment testing, random testing, and post-accident testing, and has been effective in reducing the number of accidents caused by impaired driving. According to the Department of Transportation, the positive drug test rate for safety-sensitive transportation employees in the US has decreased from 1.86% in 2006 to 0.67% in 2019 (DOT, 2021).

To reach unions and promote the use of their real-time impairment detection tool, IDT companies can use several strategies. Developers can leverage its existing relationships with companies and employers who are already using its device. By demonstrating the effectiveness of their IDT in reducing the risks of impairment-related accidents, the developers can encourage employers to share their positive experiences with unions and promote the use of the device in their workplaces.

Another way to reach unions is to attend union conferences and events to showcase their device and educate union leaders and members on the benefits of impairment detection in the workplace. Union conferences provide an excellent opportunity for IDT developers to connect with union leaders and members, discuss workplace safety issues, and demonstrate how their technology can help reduce the risks of accidents caused by impairment.

Lastly, developers can use social media and digital marketing to reach unions and union members. By creating targeted advertising campaigns and social media posts highlighting their device's benefits, developers can reach a wide audience and generate interest in their product. It might be hard to reach a specific group, but nowadays social media and digital marketing are helping many organizations.

Another union that has taken a proactive stance in promoting workplace safety is the United Steelworkers, which represents workers in various industries, including mining. The union has advocated for the use of IDTs, such as breathalyzers and drug testing, to prevent accidents caused by impairment (United Steelworkers, 2012). In addition, the union has called for the implementation of comprehensive safety programs that include training, hazard assessments, and the use of personal protective equipment.

Overall, reaching unions and promoting the use of real-time impairment detection tools requires a multi-pronged approach. By leveraging existing relationships, attending conferences and events, partnering with labor organizations, and using digital marketing

strategies, developers can raise awareness of their device and promote a culture of safety in the workplace. By promoting member safety through the use of impairment detection technologies, unions are not only protecting their members but also promoting a culture of safety in the workplace. This ultimately benefits both employees and employers by reducing the risk of accidents and improving productivity.

5.2.3 Collaborating with Regulatory Organizations

Collaborating with regulatory organizations like OSHA or other government organizations can also be beneficial for developers. Developers can collaborate with regulatory organizations to market their devices in several ways:

1. Joint marketing campaigns: IDT developers can work with regulatory organizations to create joint marketing campaigns that promote the benefits of impairment detection in the workplace. These campaigns can include case studies, webinars, and other educational materials demonstrating the effectiveness of developers' real-time impairment detection tool.
2. Industry events: IDT developers can participate in industry events that regulatory organizations sponsor. By attending these events, developers can showcase its device and demonstrate how it can help improve workplace safety.
3. Webinars and training sessions: IDT developers can collaborate with regulatory organizations to host webinars and training sessions that educate workers and safety professionals on the importance of impairment detection. These sessions can include demonstrations of their IDT and training on how to use it effectively.
4. Research partnerships: Developers can work with regulatory organizations to conduct research on the effectiveness of impairment detection tools in the workplace. By collaborating on research projects, developers can demonstrate the efficacy of its device and build credibility with potential customers.
5. Regulatory endorsements: IDT developers can seek endorsements from regulatory organizations to promote the use of their device in the workplace. Endorsements from trusted regulatory bodies can help build trust and credibility with potential customers and improve the device's reputation in the marketplace.

Creators can partner with labor organizations and industry associations to promote the use of their device. These organizations have established relationships with union leaders and members and can help their organization reach a broader audience. For example, developers can partner with the NSC, OSHA, and/or the DOT. By partnering with these organizations,

creators can benefit in multiple ways. They can create different training and education on the use of their device and impairment in order to help workers, union members, and safety professionals understand the benefits of impairment detection in the workplace. Apart from that, they can work with these organizations to learn more about the different companies that might benefit from using the developer's IDT. By knowing this, they can use the industry associations' data and knowledge to modify their approach and make them more accustomed to what companies in the industries want. Also, the contacts that the industry associations have, such as companies and union leaders, might help developers have a direct connection with those and work with them to promote and sell their devices to their companies.

5.2.4 Cost-Saving Solution

Based on the analysis from Section 3.4, it appears that IDTs do not provide a significant cost benefit when not factoring in the projected cost savings from incidents prevented and their associated costs. In short-term it is an investment, in the long-run it is a safety device that provides unmatched coverage of impairment testing per person.

5.2.5 IDT Developers Online Marketing Network

IDT developers need to create a new online marketing plan in order to reach a larger audience of potential new customers and also target the specific groups they want to reach. The benefits of creating a digital marketing plan are that the company can:

1. Wide reach: Online marketing allows businesses to reach a large audience of potential customers all over the world. With the internet, businesses can reach customers in different countries and regions at any time.
2. Targeted advertising: Online marketing allows businesses to target specific groups of people with their advertising. This means that businesses can create personalized and relevant messages that resonate with their target audience. This is possible through the use of data-driven marketing techniques, such as retargeting, lookalike targeting, and demographics targeting.
3. Cost-effective: Online marketing is often more cost-effective than traditional marketing methods like TV or print ads. It allows businesses to track their return on investment and optimize their marketing efforts in real-time.
4. Measurable results: Online marketing provides measurable results through various tools like Google Analytics, which allows businesses to track website traffic,

customer behavior, and sales. This information can be used to measure the success of marketing campaigns and optimize them accordingly.

5. Flexibility: Online marketing allows businesses to quickly and easily adjust their marketing strategies based on market trends and customer behavior. This is because it is easier to make changes to online campaigns than it is with traditional marketing methods.

Everyone is connected to the online world and platforms, and companies are using all the data that exists and that it is available in their favor. Developers can use multiple online platforms in order to reach a larger audience than what they are currently reaching. One way to use online platforms to is to create different accounts on platforms such as Instagram or Twitter, and also keep using LinkedIn and Facebook accounts that already exist. After creating and connecting all of those accounts, creators needs to be more active by creating more online content that is simple and quick to understand for the viewer. Creating more online content on these platforms will help them reach more individuals and have more interactions with other accounts. This content can then be used to partner with influencers and then they can share different posts with their followers. That is the importance of having an active account that can share content with social media users.

Another way for developers to use online platforms is to create advertisements on different platforms. 72% of B2B marketers who use paid marketing channels online use social media as a marketing medium (Socialbuzz, 2023). For example, creators could create ads that will pop up on Google, using Google ads. Apart from that, the platforms mentioned before such as Instagram, Facebook, Twitter, or LinkedIn, have the option to create ads from your own account. Meaning that developers could create advertisements and post them on those different platforms in order to reach more accounts. Social ad impressions increase by 20% every year When it comes to Facebook, in 2020, the average Facebook user clicked at least 12 ads per month, while Facebook ads reach 1.95+ billion of the platform's total monthly users. Twitter users spend 26% more time than users on other platforms in viewing ads and Twitter Ad engagements increased by 29% in Q4 2019. And when it comes to LinkedIn, LinkedIn ads reach 12% of the world's population and 62% of Americans (SociallyBuzz, 2023). These are three very good platforms that can be used to post advertisements, that way increase the reach of customers.

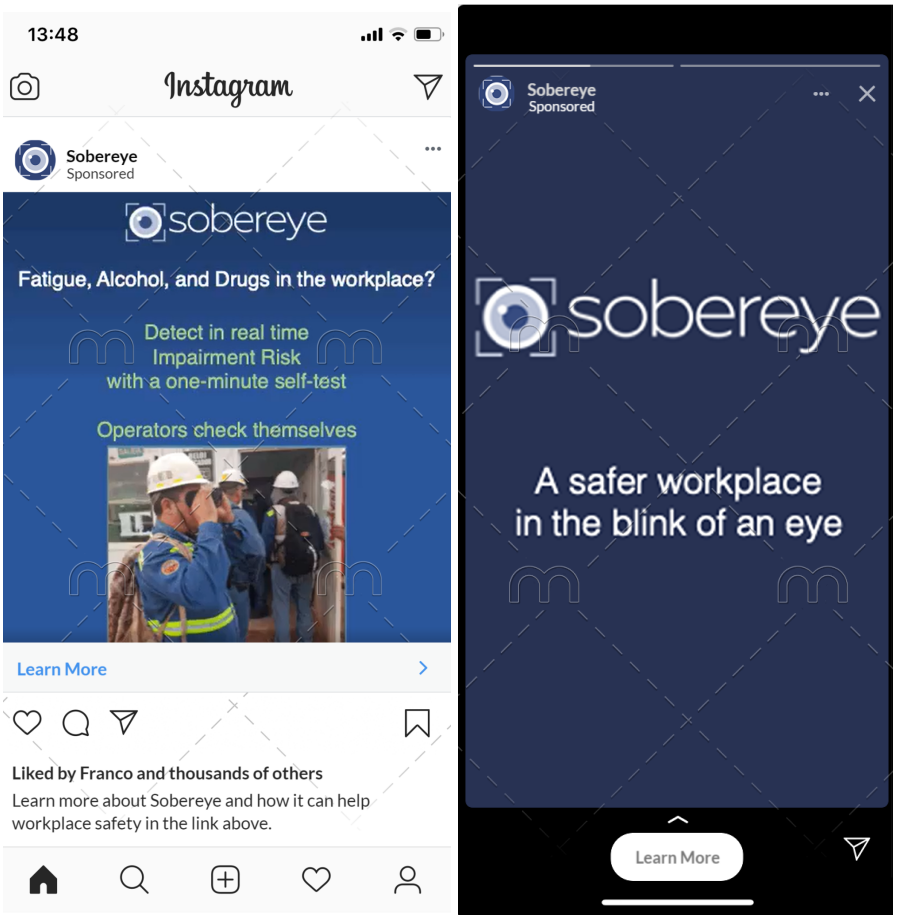

Figure 5.2.5: *Examples of Instagram advertisements that Sobereye could create and post.*

By doing this, a great tool that comes with online marketing is its analytics of it. Any individual, company, or group that uses platforms to reach an audience, has the advantage that they can gather data. Many platforms already have this implemented. For example, with Instagram, one can create multiple types of content such as stories, posts, and more. Once an account posts anything on its behalf, Instagram will gather data on that post, such as views, individual accounts reached, profile views, and more. This can help an organization keep track of and gather data that could be very helpful for making decisions.

Conclusion

In conclusion, impairment detection technologies (IDTs) provide a solution to an important safety concern in workplaces and communities. As drug and alcohol use becomes more prevalent, the risks of impairment-related accidents and incidents increase, putting employees and the public in danger. IDTs, offer a proactive approach to mitigating these risks, allowing employers to detect impairment in real-time and take appropriate action to prevent accidents before they occur.

To successfully market IDTs, developers should consider partnering with distributors and industry associations, collaborating with unions and regulatory organizations, and using online advertising and digital marketing strategies. By working with distributors and industry associations, IDT companies can leverage existing relationships and networks to reach a broader audience and build trust with potential customers. Collaborating with unions and regulatory organizations can help developers build credibility and promote the benefits of impairment detection technologies in the workplace. Finally, digital marketing strategies can help companies reach a wider audience and create targeted messages that resonate with their target market.

Furthermore, it is important to highlight that the initial cost of IDTs might not provide significant cost savings in the short-term, but it is a safety device that provides unmatched coverage of impairment testing per person. The investment in IDTs will ultimately lead to a safer workplace and communities, reducing the costs associated with accidents and incidents.

Overall, the benefits of implementing IDTs in the workplace far outweigh the costs. By preventing impairment-related accidents and incidents, employers can improve safety, reduce costs associated with accidents, and ultimately improve productivity. Developers of IDTs need to be proactive in their marketing efforts and seek out partnerships with distributors, industry associations, unions, regulatory organizations, and use online advertising and digital marketing strategies to reach a broader audience and promote the use of these life-saving technologies. By doing so, they can help create a safer workplace and communities for all.

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Appendix A: List of Trade Shows and Conferences

Appendix A. 1 Construction Industry

Construction Industry Trade Shows/Conferences	
Name	Date
2023 AGC Construction Safety & Health Conference	Jan. 18-20, 2023 (Annual)
2023 Construction Expo and Safety Conference	March 6-7, 2023 (Annual)
The Utility Expo	Apr. 30 – May 4, 2023
Equip Expo	Oct. 18 – 20, 2023

Appendix A. 2 Mining Industry

Mining Industry Trade Shows/Conferences	
Name	Date
MineXChange	Feb. 26 - March 1, 2023
41st Annual South-Central Joint Mine Health and Safety Conference	Apr. 3 – 5, 2023
Mining Health and Safety Conference	Apr. 18-20, 2023
National Holmes Mining Safety and Health Conference	Jun. 27 – 29, 2023
19th Annual Mine Safety & Health Conference	Oct. 23 -25, 2023
MineExpo International	Oct. 24 – 27, 2023

Appendix A. 3 Transportation Industry

Transportation Industry Trade Shows/Conferences	
Name	Date
ATSSA's Convention & Traffic Expo 2023	Feb. 17-21, 2023 (Feb 2-6, 2024)
Technology & Maintenance Council Annual Meeting & Transportation Technology Exposition	Feb. 27 – March 2, 2023.
Commercial Vehicle Safety Alliance (CVSA) Annual Conference and Exhibition	Sept. 18 – Sept. 22, 2023
LifeSavers Conference	Apr. 2-4, 2023
Technical Training and Product Expo	March. 14
NSC Spring Safety Conference & Expo	May 17-19

Appendix A.4 Extra Safety and Health Conferences

Health and Safety Conferences and Expos	
Name	Date
North Dakota Safety Council Safety & Health Conference	Feb. 21-24
Utah Safety Conference & Expo	March 16-17
81st Annual Wisconsin Safety Conference	April 17-19
Iowa-Illinois Safety Council 70th Professional Development Conference & Expo	April 25-27
Minnesota Safety & Health Conference & Expo	May 2-3
Leadership Conference on Safety	May 10-12
NSC Spring Safety Conference & Expo	May 17-19
40th Annual Safety and Health Summit	Oct. 3-4
South Dakota Safety & Health Conference & Expo	Oct. 4
Chesapeake Region Safety Council Safety & Health Conference & Expo	Oct. 4-5
NSC Safety Congress & Expo	Oct. 23-25

Appendix B: Information on Other Impairment Detection Devices

Tech	Headquarters	Year product launched	Pricing	Test duration	Recommended test deployment	Delivery application	Primary industries
AlertMeter	United States & Canada	2015	Monthly subscription	Approx. 60 seconds	Pre-shift; during shift; post-shift	Any touchscreen device	Ag, C, HC, M, Mn, U, MT, T/W
Druid	United States	2018	$30-99 per year per user (USD)	3 minutes	All intervals (except continuously)	Touchscreen tablet or smartphone	C, Ed, F/I, HC, M, Mn, PST, T/W, U, Ag, RT, PST, F/I, MC, WT
ExceleRATE/ Vitals	Canada	2012 - closed studies with law enforcement	Initial setup and training fee per assessment or annual license fee	20-25 minutes	Pre-hire; post-incident; random; return to work	Mobile tablet	T/W, other safety sensitive industries
Fit for Work	Canada	**	Setup fee plus monthly for 1, 2 or 3 year terms with unlimited scans	Up to 5 seconds	All intervals (except continuously)	Fixed "Safe Entry Stations"	Ag, C, HC, M
F2D2	Germany	2015 (F2D launched in 2006)	**	Up to 11 minutes	**	Head-based device	**
Guardian	Australia	**	**	**	Continuously	Fixed-location device	T/W
Optalert	Australia	Initial product built in 1994	Hardware/algorithm upfront cost + annual subscription	5 minutes	Pre-shift; during shift; post-shift; continuously;	In-cab hardware; wearables	A/F, A/W, Ag, Ed, F/I, HC, I, MC, Mn, PST, T/W, U
OSPAT	Australia	1993	Annual license on average $100 per user (USD)	1 minute	Pre-shift	Computer-based assessment	C, M, Mn, T/W, U
PMI FIT 2000	United States	**	Flat fee or annual service plan	23 seconds	Pre-shift	Mobile and fixed location device	Mn
PVT Workfit	United States	**	Annual subscription based on # of employees	3 minutes	Pre-shift; during shift; post-shift; monthly	Tablet, smartphone or computer	M, Mn, PST, T/W, U, WT
PVT-192	United States	**	$3,000 flat fee (USD)	1- 20 minutes	All intervals (except continuously)	Handheld device	**
SafetyScan	Canada	Expected 2022	SaaS business model with a price per user (various discounts available)	30 seconds	Pre-hire; pre-shift; during shift; post-shift; post-incident; randomly	Fixed-location device & portable system available	A/F, A/W, C, U, M, MT, T/W, Mn, Ag, RT, PST, HC, Ed, F/I, U, I, MC, WT
SOBEREYE	United States	On the market since 2018	Subscription-based service	1 minute	Pre-shift; during shift	Handheld device	C, M, Mn, T/W, U
WIT	Canada	Not yet on the market	WIT certification is $1,200 per tester; $50/month fee +a $1-3 fee per use of the test (USD)	15 minutes	Pre-hire; post-incident; random; pre-entry to external worksites; post- near miss; new medication check	Mobile app and trained evaluator	Ag, C, M, Mn, T/W
Zxerex Safe	United States	Beta product launched in 2021	Monthly fee based on total # of employees	2 minutes	Pre-hire; pre-shift; during shift; post-shift; post-incident; random	Fixed-location device	A/F, A/W, Ag, C, Ed, HC, M, Mn, RT, T/W, U

Key: A/F = accommodation and food services; Ag = agriculture, forestry, fishing, hunting; A/W = administration and support and waste management; C = construction; Ed = education; F/I = finance and insurance; HC = health care; I = information; M = manufacturing; MC = management of companies and enterprises; MT = maritime; Mn = mining; PST = professional, scientific, and technical services; RT= retail trade; T/W = transportation and warehousing; U = utilities; WT = wholesale trade

*All data are based on self-reported information collected from the respective technology vendors, as well as a scan of readily available public documents and scientific evidence (e.g., peer-reviewed, and unpublished scientific papers). Data presented in this report are intended for informational purposes only and are not intended to represent the views or policies of the National Safety Council.

** Unable to obtain sufficient evidence

Appendix C: List of Distributors

Top Personal Protective Equipment Distributors in the United States	
Distributor	Location
3M	Saint Paul, MN
Honeywell International	Charlotte, NC
Ansell	Iselin, NJ
MSA Safety Lindstrom Group	Cranberry Township, PA Blaine, MN
Alpha ProTech	Markham, Canada
DuPont de Nemours	Wilmington, DE
Johnson Safety Products	San Bernardino, California
Avon Rubber W.W. Grainger	Cadillac, MI Lake Forest, IL
Northern Safety Co.	Frankfort, NY
Radians Draeger	Memphis, TN Andover, MA
Mersi Distribution McKesson	Miami, FL Irving, TX
Cardinal Health Medline Henry Schein	Dublin, OH Northfield, IL Melville, NY
Fastenal Uline	Winona, MN Pleasant Prairie
Ritz Safety	Dayton, OH

Appendix D: Glossary

Term	Definition
NSC	National Safety Council
OSHA	Occupational Safety and Health Administration
MSHA	Mine Safety and Health Administration
DOT	Department of Transportation
FMCSA	Federal Motor Carrier Safety Administration
PPE	Personal Protective Equipment
BLS	Bureau of Labor Statistics
IDT	Impairment Detection Technologies