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THE IMPACT OF THE LEGALIZATION OF MARIJUANA
ON SUPPLY CHAIN OPERATIONS

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ABSTRACT

The purpose of this thesis is to provide an analysis of key issues and considerations for a supply chain organization in regards to the impact of the legalization of marijuana on business operations. The main areas to be explored include legal considerations, the physical and cognitive effects of marijuana on an individual, the nature logistics functions and governmental regulations, and drug testing methods. Discussion on these issues will be based on current legislation and relevant research findings as well as on interviews with industry experts.

Through this research it was determined that the best approach for companies evaluating their drug policies in response to the legalization of marijuana is to maintain and reinforce a zero-tolerance drug policy. Prohibiting marijuana use by employees is consistent with and protected under federal legislation and avoids many of the issues and complexities involved in the management and testing for marijuana use in employees. As research on marijuana use and development of improved testing methods continues to progress, companies may consider reevaluating their policies.

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Chapter 1

Introduction

Marijuana is currently classified as a Schedule I drug, meaning it is recognized as having a high potential for abuse as well as having no recognized medical benefit. Yet, it has been legalized for recreational use in eight states and has been legalized for medical use or decriminalized in many others. This trend is expected to continue for both medical and recreational use as more research is done on the effects of marijuana. While this spreading movement has many social, political, and medical implications, it also has a huge impact on businesses across the country. The implications are particularly prevalent with the highly-regulated, highly-mechanized field of supply chain. For the purpose of this thesis, the focus will be on companies' responses to the legalization of marijuana according to their policy for employees in the fields of distribution and transportation.

As marijuana is legalized for both medical and recreational use in more states, companies are forced to reevaluate their corporate policy regarding drug use. They have the option of maintaining a zero-tolerance policy against marijuana use or aligning corporate policy with state laws and allowing use during non-working hours. Because marijuana is still illegal under federal legislation, companies maintain the right to prohibit its use. In fact, Colorado Amendment 64, which legalized recreational marijuana use, states: "Nothing in this section is intended to require an employer to permit or to accommodate the use... of marijuana in the workplace or to affect the ability of employers to have policies restricting the use of marijuana by employees" (Colorado Amendment 64, 2012).

At this point in time, research on the effects of marijuana has been limited to select institutions because of its classification under the Drug Enforcement Agency's (DEA). Controlled Substances Act (CSA). However, there is potential legislation to reclassify the drug to a lesser controlled status, which would ultimately ease research efforts and officially acknowledge the positive medical benefits of marijuana use that have been discovered. This legislation is expected to be considered in the near future, but it will still take many years for significant, esteemed research results to emerge and influence companies on reforming their corporate policy.

This thesis will explore the most recent research findings and laws regarding marijuana use in the context of the workplace and while operating machinery and vehicles. The complexities of accurate testing will then be explored. Other topics of exploration include safety regulations in the supply chain industry, common business reactions, and impact of corporate policy on recruitment and retention of employees. For each of these issues, there is either lack of research, conflicting perspectives, or technical barriers. Through the exploration of current research and analysis of industry expert opinions, this thesis will provide an outline of issues to be considered and ultimately provide a recommendation for an approach on how companies should approach developing corporate policy on employee use of marijuana as it is legalized in their main areas of operation.

Methodology

The analysis of key issues that businesses are facing in response to the legalization of marijuana will be based on three main sources: (1) secondary data publicly available; (2)

consultation with medical professionals regarding the current state of research and testing for marijuana; and (3) interviews with corporate executives on current testing practices and reactions to the legalization of marijuana. Data to be analyzed include the topics of research on the effects of marijuana, current legislation at the federal and state level, common testing practices, regulations impacting supply chain operations, and other relevant topics. Medical professionals will be consulted to determine the credibility and accuracy of studies on the physical and cognitive effects of marijuana as well as current testing practices. The purpose of this consultation is an attempt to reduce some of the inconsistency and ambiguity present in differing research results that have been published. Interviews with corporate executives of logistics and transportation providers will be conducted to assess what the key areas of concern are for corporations affected by the legalization of marijuana, specifically in the areas of supply chain management. Interview questions will seek to obtain information on current business practices regarding drug and alcohol testing, including testing method and timing, as well as corporate policy for drug and alcohol use. The issues of safety regulations and accidents specific to supply chain functions will then be discussed. Finally, the main concerns that the executives have regarding the business issues in relation to the legalization of marijuana will be addressed. Appendix A provides a full copy of the interview guide used to facilitate the conversations with executives.

Chapter 2

Background

History of Drug and Alcohol Testing

Employee drug testing began in the 1960s and 1970s in the military as an attempt to identify current use and deter continued use of drugs amongst personnel serving in the Vietnam War. Over the next decade, all branches of the military implemented urine drug testing for their personnel. In 1981, a Marine Corps jet crashed, killing fourteen crew members and injuring dozens more. This incident was attributed to the use of marijuana, which was found in many of the crew members' systems in post-accident testing. As a result of this incident and other safety related incidents, the Department of Defense implemented a zero-tolerance policy for drug use and began working with other divisions of the federal government on strategies to combat drug use (Historical Overview, n.d.).

Following the "proven successes of the military drug testing program, along with advances in immunoassay techniques for high-throughput drug screening," (Historical Overview, n.d.), many other industries began conducting drug tests on employees. In 1983, the Federal Railroad Administration (FRA) implemented a comprehensive drug testing program in response to the developments in drug testing methods as well as recent transportation accidents involving drug or alcohol use. Other safety sensitive industries quickly followed suit, including oil, transportation, and chemical companies. As the prevalence of employer drug testing expanded across the country, there was a corresponding increase in lawsuits against the validity and

appropriateness of drug testing. In the late 1980s, the Reagan Administration responded to this by issuing the Federal Drug-Free Workplace Program, which required all federal employees as well as employees of companies who contracted with the federal government to undergo drug testing. This included the creation of standardized procedures regarding the method for collection and testing of specimens by accredited laboratories (Historical Overview, n.d.).

As the use of drug tests became established under the federal government and certain safety sensitive industries, many private employers began exploring the idea of drug testing their employees with the intent to promote maximum productivity and safety in the workplace. Private companies continued to follow the federal government's lead, aligning their drug testing programs to the guidelines laid out by the Department of Health and Human Services (DHHS) and using DHHS-accredited laboratories. Today, it is reported than almost ninety percent of Fortune 1000 companies and sixty-two percent of all companies in the U.S. have drug testing programs for their employees (Historical Overview, n.d.). While each company who chooses to participate in drug testing of employees must follow federal guidelines, there are many differences in intent and implementation of the programs between industries and individual companies.

Current Standard Procedures

Drug and alcohol testing is common practice by employers to prevent and identify use of illicit drugs by employees, a behavior that can lead to significant safety and health hazards for the individual and those around them. The Drug and Alcohol Testing Industry Association

(Workplace Drug Testing, n.d.) provides seven main reasons employers engage in drug and alcohol testing, including:

1. Deter employees from abusing alcohol and drugs
2. Prevent hiring individuals who use illegal drugs
3. Be able to identify early and appropriately refer employees who have drug and/or alcohol problems
4. Provide a safe workplace for employees
5. Protect the general public and instill consumer confidence that employees are working safely
6. Comply with state laws or federal regulations
7. Benefit from Workers' Compensation Premium Discount programs

While private employers are not required to conduct formal drug testing, the DHHS Substance Abuse and Mental Health Services Administration (SAMHSA) has set guidelines for testing effectively and in accordance with the law that many employers choose to follow.

The most common method for conducting drug testing is urinalysis, as it is a non-intrusive, cost-effective method and specimens are easy to collect and manage. SAMHSA's guidelines include standards to ensure accuracy and validity in the testing process, including using qualified laboratories, documented chain of custody, initial screen and confirmation test procedures, split sample testing, and storing and protecting of personal information. Exhibit 1 (Workplace Drug Testing, n.d.) provides a summary of alternate testing methods.

Exhibit 1 Drug and Alcohol Testing Methods

Testing Method	Description
Urine	Results of a urine test show the presence or absence of drug metabolites in a person's urine. Metabolites are drug residues that remain in the body for some time after the effects of a drug have worn off. This test does not necessarily mean a person was under the influence of drugs at the time of the test but rather shows drug use during the past few days or weeks. Urine tests are considered more accurate for detecting illicit drug use over alcohol use.
Breath	A breath-alcohol test is the most common test for finding out how much alcohol is currently in the blood. The person being tested blows into a breath-alcohol device, and the results are given as a number, known as the Blood Alcohol Concentration (BAC), which shows the level of alcohol in the blood at the time the test was taken. BAC levels have been correlated with impairment. Under DOT regulations, a BAC of 0.02 is high enough to stop someone from performing a safety sensitive task.
Blood	A blood test measures the actual amount of alcohol or other drugs in the blood at the time of the test. Blood samples provide an accurate measure of the physiologically active drug present in a person at the time the sample is drawn. Although blood samples are a better indicator of recent consumption than urine samples, there is a lack of published data correlating blood levels for drugs and impairment with the same degree of certainty that has been established for alcohol. There is also a very short detection period, as most drugs are quickly cleared from the blood and deposited into the urine.
Hair	Analysis of hair provides a much longer "testing window," giving a more complete drug-use history going back as far as 90 days. Like urine testing, hair testing does not provide evidence of current impairment, but rather only past use of a specific drug. Hair testing cannot be used to detect for alcohol use. Hair testing is the least invasive form of drug testing, therefore privacy issues are decreased.
Oral fluids	Saliva, or oral fluids, collected from the mouth also can be used to detect traces of drugs and alcohol. Oral fluids are easy to collect (a swab of the inner cheek is the most common collection method), harder to adulterate or substitute, and may be better at detecting specific substances, including marijuana, cocaine and amphetamines/methamphetamines. Because drugs do not remain in oral fluids as long as they do in urine, this method shows promise in determining current use and impairment.

The SAMHSA's guidelines recommend testing for use of at least five main illicit drugs, including amphetamines (meth, speed, crank, ecstasy), tetrahydrocannabinol (THC) (cannabinoids, marijuana, hash), cocaine (coke, crack), opiates (heroin, opium, codeine, morphine), and phencyclidine (PCP, angel dust). Employers are able to test for additional substances as well, including other illicit drugs as well as prescription pharmaceuticals that may be used legally but could still cause impairment. Different drugs have varying "detection windows" in which they are in the user's system and detectable by any of the methods described. Alcohol is processed by the body very quickly and testing must be done within a few hours of use, while most drugs are detectable for a couple of days to a couple of weeks post-use. Marijuana, for instance, can be detected for three to four days after a single use up to multiple

weeks for chronic users. Aside from alcohol, positive drug test results do not directly correlate to level of impairment (Workplace Drug Testing, n.d.).

Employers may require drug testing for a variety of reasons, including pre-employment, reasonable suspicion, post-accident, and random testing. Pre-employment testing is conducted to prevent hiring employees who use illicit drugs. This screening test is intended to prevent any future issues involving lost productivity or mistakes made due to drug impairment as well as mitigate safety risks for the individual and their peers for those in safety sensitive positions. Reasonable suspicion testing is conducted as needed following the recommendation of a supervisor specifically trained in recognizing signs and symptoms of drug or alcohol use. It is vital that employers have a defined training and reporting system on what qualifies as significant signs of violation of drug or alcohol policy to prevent any legal personnel issues. Post-accident testing is conducted following an incident that resulted in property damage or personal harm to determine if drugs or alcohol could have been part of the cause of the accident. Most employers have set guidelines for when post-accident testing should occur based on the severity of the accident, such as a death or serious injury requiring professional care or property damage over a certain dollar amount. As mentioned previously, it is also critical for post-accident testing to be conducted as soon as possible after the accident as substances may be eliminated from the individual's system within a few hours. Important to note is that the presence of drugs or alcohol in the system do not necessarily prove that substance use was the cause of the accident, but it does lead to further investigation. Random drug testing is also used by employers to serve as a deterrent for substance use. Random drug tests are conducted both at random intervals as well as with a randomly selected sample of employees (Workplace Drug Testing, n.d.).

All methods are typically lawful for an employer to require current or potential employees to participate in, but there are some restrictions in certain states. Some states, such as California, restrict random testing of employees unless they are in a position that is considered safety sensitive. Some federal agencies also have additional requirements for drug testing, such as the Department of Transportation. Drug and alcohol testing is typically considered necessary and beneficial for ensuring a healthy and safe work environment for employees (Workplace Drug Testing, n.d.).

Chapter 3

Interviews

Interviews were conducted with executives in the areas of safety, transportation, and regulatory compliance for three transportation and logistics providers. The purpose of the interviews was to gain insight on each company's current practices for drug and alcohol testing and address any issues or concerns relevant to the business. Each being a part of the transportation industry, there were many common themes between the interviews.

Policy and Testing Procedures

The majority of the employees for each of the companies interviewed fall under Department of Transportation (DOT) regulation, meaning they are subject to DOT drug and alcohol testing requirements. Under the DOT's Federal Motor Carrier Safety Administration (FMCSA), urinalysis drug testing must be conducted by each company both pre-employment and at random. Both urine and breathalyzer tests are used for alcohol testing. Each company interviewed has a drug testing system in compliance with these federal requirements with additional processes specific to their business needs.

Company A has a random testing schedule in place for one hundred percent of the employees, above the mandated twenty-five percent under the DOT, due to a customer requirement. This customer contracts with company A to carry hazardous materials, explaining

the increased measures for protection. They also test on a nine drug panel, testing for several extra substances than required in the DOT mandated five drug panel. Company B outlined all of the possible circumstances in which a driver is subject to testing, including post-accident, reasonable suspicion, and return to duty situations. Company C has a large business unit of employees not under the DOT, but they have similar policies for drug and alcohol testing for this group. Other employees are subject to both pre-employment and random drug testing; though random tests are only conducted on approximately ten to twenty percent of employees. Many employees in the alternate group also work in positions considered safety sensitive, as warehouse operations is another main business unit of Company C. Company C also conducts reasonable suspicion drug testing as needed.

All three companies interviewed have a zero-tolerance policy for drug use with immediate separation or discharge if a positive test result is received. Company A reports that their recently implemented drug testing procedures following any injury on the job has already resulted in the termination of five employees. Each company maintains a zero-tolerance policy across the entire organization, regardless of geographic location or business unit.

Governmental Regulations

In addition to ensuring compliance with all DOT regulations for testing and other processes, the executives interviewed explained other government regulations relevant to their business. The Occupational Safety and Health Administration (OSHA) has many regulations that impact all businesses, not just those in the transportation industry. The purpose of OSHA is to ensure "safe and healthful working conditions for working men and women by setting and

enforcing standards" (About OSHA, n.d.). A major part of maintaining a safe working environment is ensuring employees, especially those operating heavy machinery or in other safety sensitive positions, are drug-free and not impaired in any capacity. Random drug testing is an effective method of deterring and identifying substance abuse in the workplace, and the subsequent termination of employees is done in part to protect the safety of the work environment for all other employees. Other government agencies that impact the businesses operations include the Environmental Protection Agency and the state level Department of Environmental Protection, both of which impose additional regulations on safety as they relate to the transportation of hazardous materials.

Reactions to the Legalization of Marijuana

One reason to consider reevaluating drug policies is the shortage of employees to fill many positions in the supply chain industry. Two of the companies interviewed are experiencing the effects of such shortage on their recruiting of both truck drivers and warehouse workers. However, neither believe that lenient drug testing will resolve the issue.

Under the DOT, there is little flexibility for transportation providers to adjust drug testing policies or methods. For this reason, the executives reported other strategies to grow their workforce. Company A believes that the truck driver shortage stems from a variety of reasons including quality of life issues, increasing government regulations, low pay rates, and changing demographics. Over half of their drivers are over fifty years old and approaching retirement, and the industry they compete in has an even more limited pool of workers due to the hazardous material they transport. Company A's strategy to recruit more workers involve penetrating

markets with recruitment material, including utilizing online advertisements, attending local events, and offering sign-on bonuses. Company C also experiences a significant worker shortage in their operations, though they believe it is a result of the competitive area they are operating in. Their strategies to combat worker shortage involve trying to improve the working environment and offering additional benefits for their employees, including paying above average wages compared to the market, fostering a positive culture in the organization, and offering a competitive benefits package to employees.

Despite the elimination of potential employees due to positive drug tests potentially worsening the shortage of employees, the executives interviewed do not expect their policies regarding drug use or testing to change in the near future. Being under the DOT puts the companies under strict federal regulation. As marijuana is still illegal at the federal level, these companies must continue to consider it an illicit substance. The executive from company A believes that marijuana use should be treated in a similar fashion to alcohol use, permitting use outside of working hours. As part of the recruitment and retention issues stem from the increasing pressure of government regulation, loosening regulations on employee management policies may be beneficial. Changing corporate policies may further help with the retention of employees as they would not have to terminate an employee in response to a positive drug test who was not posing any risk to the safety of themselves or others. Additionally, it would be beneficial for a company's financial health to reduce the requirements on drug testing, especially for a company whose employees are unionized, as this often requires the implementation of a rehabilitation and follow-up testing program for employees who test positive for drug use.

The general consensus for the companies in response to the legalization of marijuana is to not make any changes to their current policies. In the supply chain industry, many of the

companies are unable to adjust policies due to DOT restrictions. However, it is important for companies to understand the issues and complexities associated with the legalization of marijuana and its potential to impact their operations. There are also opportunities and alternative options to be explored that companies may consider in the future.

Chapter 4

Discussion

Current Legal State

As previously stated, marijuana is currently classified as a Schedule I drug under the Controlled Substances Act, which is the most carefully controlled group of the five classifications (Pastore, Contacos-Sawyer, & Thomas, 2013). According the U.S. DEA, this means that the drug has a high potential for abuse and has no recognized medical benefit to users. Other drugs in the Schedule I classification include heroin and LSD, while cocaine is classified as a Schedule II drug (Drug Enforcement Administration, n.d.). Schedule I classification imposes rigid control on the possession, distribution, and dispensing of the drug (Pastore et al., 2013). To many, this top level classification does not seem appropriate. In fact, marijuana is the "most commonly used illegal drug in the U.S." (National Institute on Drug Abuse, 2010), indicating that the public does not agree with the DEA that marijuana is one of the most dangerous drugs on the market. As shown in Exhibit 2 (Dougherty, 2016), the public perception of risk of marijuana use has declined at a constant rate over the past few years. Additionally, positive drug tests in the U.S. increased 14.3 percent from 2013 to 2014, with an overall incidence rate of 2.4 percent of all tests (Workplace Impacts, n.d.), further indicating the public acceptance of the drug. While this may seem insignificant, Quest Diagnostics performed over 7.6 million drug tests in 2014, meaning over 180,000 people were taken out of the labor force due to marijuana use from those tests alone (Workplace Impacts, n.d.). Furthermore, the positivity rates in Colorado and Washington, the first two states to legalize the drug, were above

the national average at a twenty percent and twenty-three percent increase, respectively

(Workplace Impacts, n.d.). Legalizing the drug in just two states had a significant impact on the

prevalence of marijuana, and the negative stigma of using the drug is likely to continue to fade

following legalization in more states.

Exhibit 2 Percentage perceiving risk from smoking marijuana once a month
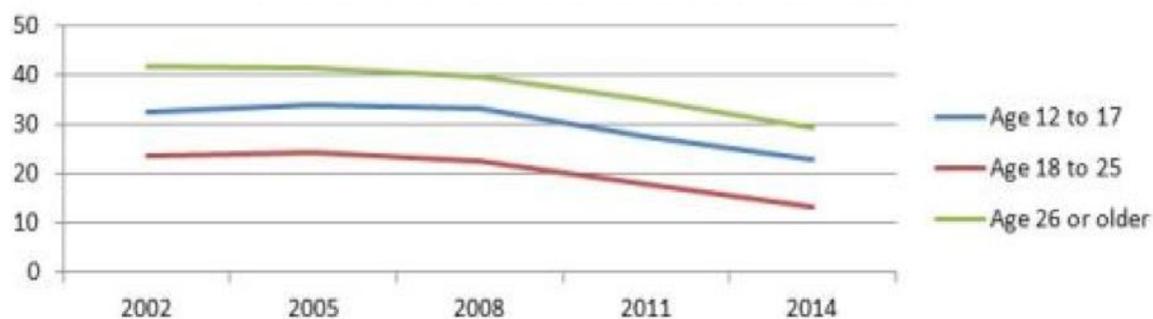
In addition to public opposition to the current status of marijuana, states are actively

showing their disagreement with the DEA's classification of marijuana through legislative

measures. Despite being a Schedule I drug on the federal level, many states have begun to

recognize the lack of risk of abuse as well as the potential medical benefits of the drug. As of the

latest polls in November 2016, eight states have legalized marijuana for recreational use, and

twenty additional states have legalized medical marijuana (Drug Enforcement Administration,

n.d.). The eight states that have legalized the drug for recreational use include Alaska, California,

Colorado, Oregon, Massachusetts, Maine, Nevada, and Washington, as shown in Exhibit 3 (State

Marijuana Laws, 2016).

Exhibit 3 Visualization of the legal status of marijuana in the U.S.

Marijuana Legalization Status
- Medical marijuana legalized
- Marijuana legalized for recreational use
- No laws legalizing marijuana
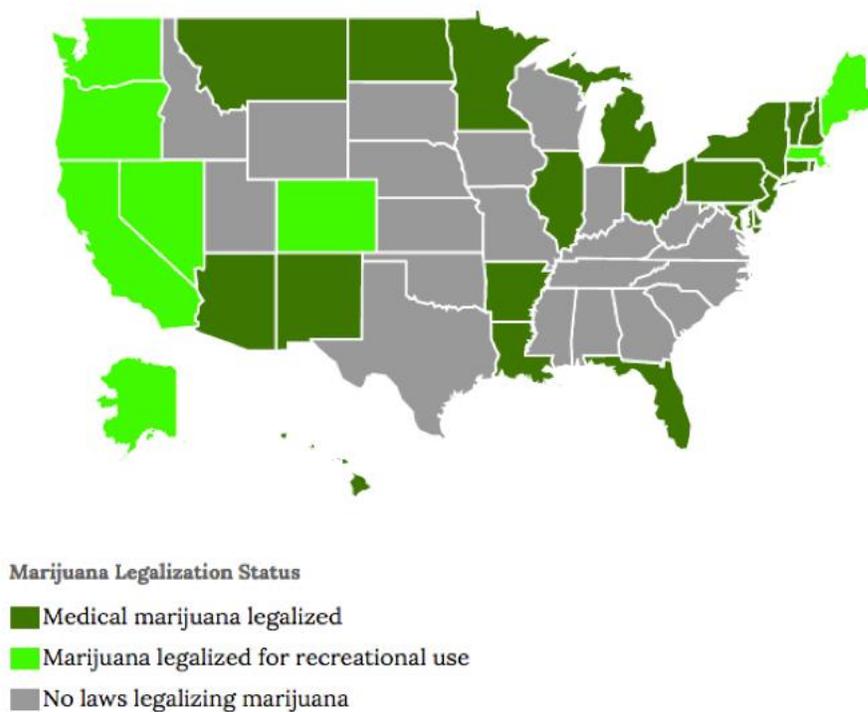
Despite the increasing public acceptance of the use of marijuana, the DEA has resisted measures to change the classification due to lack of research proving medical benefits of cannabis. However, the reason for lack of testing on the drug is a direct result of its Schedule I classification. One justification behind keeping a drug at the Schedule I status is that there is "a lack of accepted safety for use of the substance under medical supervision" (Workplace Impacts, n.d.). A major issue here is not that scientists agree that marijuana is unsafe, per se, but rather that they do not have enough evidence to prove the safety of its use. Due to its classification as a Schedule I drug, there are very strict limits on the growth, distribution, and use of marijuana, including for research purposes. Any scientist who wishes to study marijuana and its effects on an individual must get permission from federal, state, and local agencies before proceeding, and performing any research on marijuana requires a license from the DEA (Scientists to Government, 2017).

The DEA also regulates the research on marijuana by placing strict licensing and restrictions on the cultivation of the plant. Under the 1970 Controlled Substances Act, the DEA has licensed and funded only one institution, the University of Mississippi, to grow marijuana for the purpose of use in research (NIDA's Role, 2016). This means that any institution wishing to conduct research on the effects of marijuana must rely on the University of Mississippi to supply the drug to them. The DEA also has established annual aggregate production quotas, further limiting the overall amount produced to supply research (NIDA's Role, 2016).

These restrictions severely limit the type and amount of research done on the effects of marijuana, as researchers often cannot get the amount of the drug needed or the right variety of the drug needed for their study. In the fall of 2016, the DEA announced that they will begin to allow additional institutions to apply to be registered to produce and distribute marijuana for research purposes, but the process of gaining valuable research on the effects of marijuana is still lagging behind the legislation being passed regarding its use (NIDA's Role, 2016). State laws are being pushed through based on the public acceptance of marijuana and its common use, but the federal government and businesses are hesitant to provide their approval.

Physical and Cognitive Effects of Marijuana

Despite the limits placed on the cultivation and distribution of the drug, there has been some valuable research performed on understanding the effects of marijuana use on an individual. Much of the research shows unfavorable effects on cognition and psychomotor ability, which raises concern for the ability of those who use marijuana to effectively and safely do their job. Some of the short-term, cognitive effects of marijuana include distorted perceptions

of time and space, reduced ability to focus, and disruption in short-term memory and cortical processing (Gips, 2006; Hart et al., 2002). Some of the physical effects that occur while under the influence of marijuana include dulled physical reflexes and lack of coordination (Bostwick, 2012; Gips, 2006). Clearly, these are not ideal conditions for performing a job that requires any sort of mental or physical capability. In fact, the National Institute on Drug Abuse has found a linkage between marijuana use and an increase in job accidents and injuries, particularly in the transportation industry (Dougherty, 2016).

However, the main argument of proponents for the legalization of marijuana is not that it is safe to be under the influence of marijuana while conducting specific work activities, but rather that use of the drug outside of work should not be a prohibiting factor to performance in that line of work. In the study by the National Institute on Drug Abuse mentioned previously, the linkage between marijuana use and accidents in the workplace is based on employees who were under the influence of marijuana at the time of the accident. There is no reliable study that links being under the influence of marijuana outside of working hours to increased accidents and injuries in the workplace. The uncertainty regarding the long-term effects of marijuana is the major issue lawmakers and businesses are faced with.

Much of this uncertainty stems from the fact that there are numerous variables that impact how the drug affects an individual. Factors that influence the level of impairment an individual experiences depends on potency, timing, method of intake, and tolerance (Goldsmith et al., 2012). There are many different strains of marijuana cultivated that each have different levels of potency, which plays a huge role in the effects an individual may experience. This variance in potency is a result of the seed used in cultivation and the growing conditions (Goldsmith et al., 2012). Some strains of marijuana are reported to be low in THC, the main

chemical compound found in marijuana, concentration and therefore have minimal impact on safety and productivity; these strains are often marketed as being safe for workers to use (Goldsmith et al., 2012).

The Journal of Occupational and Environmental Medicine also notes that intensity of effects is also moderated by the "variability in smoking dynamics," including, "number, duration, and spacing of puffs; the hold time, and the inhalation volume" (Goldsmith et al., 2012). In addition to physical characteristics of the marijuana plant being consumed or the method of consumption, individual differences, such as tolerance for the drug, play a role in the effects experienced. Similar to other drugs or alcohol, those who have used marijuana regularly are not as severely impacted as a non-experienced user consuming the same amount of the drug (Goldsmith et al., 2012). Reports on the effects of marijuana use claim that directly observable effects and maximum impairment occur approximately fifteen to thirty minutes after use, and these effects begin to taper off or are completely absent within two to three hours after use of the drug (Goldsmith et al., 2012).

As a consequence of the uncertainty of each of these variables in the research of marijuana, including testing conditions, variance in potency of the strain, and individual differences in impairment, there is a lack of scientific consensus regarding the safety of use of the drug. The federal regulations on research have further exacerbated this uncertainty, as there is an inadequate amount of research to draw significant conclusions from. As the regulations are lifted and volume and breadth of testing increases, the effects of marijuana use will become better understood.

Overview of Logistics

Though the issue of reevaluating corporate policy in response to the legalization of marijuana is present in almost all corporations, it is especially important in the supply chain industry. The Journal of Occupational and Environmental Medicine reported that there is a "statistical association between illicit drug use, including marijuana, and workplace accidents" (Dougherty, 2016). Many functions of the supply chain require employees to perform safety sensitive jobs, such as driving a truck on interstate highways or operating a forklift in a warehouse. Positions such as these are considered safety sensitive because they have the potential to pose serious hazards to the health and safety of "the traveling public, co-workers, and yourself" (What Employees Need to Know, 2012). For this reason, many jobs in the field of supply chain are subject to strict regulations regarding the testing for drugs and alcohol.

Under the federal Department of Transportation (DOT), the 1991 Omnibus Transportation Employee Testing Act requires various DOT agencies to implement a formal process for the testing for drugs and alcohol of employees in positions considered safety sensitive. Exhibit 4 (What Employees Need to Know, 2012) lists the DOT agencies overseeing the six main areas of transportation as well as the safety sensitive positions that fall under each area.

Exhibit 4 DOT agencies and the safety sensitive positions they oversee

DOT Agency	Sample Positions
Aviation FAA	Flight crews, flight attendants, flight instructors, air traffic controllers, aircraft dispatchers, aircraft maintenance or preventative maintenance personnel, ground security coordinators and aviation screeners.
Commercial Motor Carriers FMCSA	Commercial Drivers License (CDL) holders who operate Commercial Motor Vehicles, 26,001 lbs. gvwr. or greater, or operate a vehicle that carries 16 passengers or more including the driver, or required to display a DOT placard in the transportation of hazardous material.
Maritime USCG	Crew members operating a commercial vessel.
Pipeline PHMSA	Operations, maintenance, and emergency response.
Railroad FRA	Hours of Service Act personnel, engine & train, signal service, or train dispatchers.
Transit FTA	Vehicle operators, controllers, mechanics and armed security.
Links to these regulations can be found online at https://www.transportation.gov/odapc	

Under the Omnibus Transportation Employee Testing Act, employees are subject to drug testing for the following: pre-employment, reasonable suspicion, random testing, post-accident, and follow-up/return-to-duty (What Employees Need to Know, 2012). The DOT has stricter regulations than other industries due to the high risk to safety of the individual or others if an employee is impaired while performing key responsibilities, which is inevitable if the employee is under the influence of illicit drugs. For instance, driving a truck for lengthy periods of time requires endurance of concentration and attentiveness, reactiveness, and dexterity, all of which are known to be impaired by the use of marijuana. The National Institute on Drug Abuse reports that the drug "impairs attentiveness, motor coordination, and reaction time and impacts the perception of time and speed," resulting in an increased "risk of crashes and fatal collisions" (Dougherty, 2016). Clearly, the physical and cognitive impairment caused by the use of marijuana can have serious consequences, and it is important to ensure that employees in these functions are not under the influence of the drug.

While the transportation industry has stringent regulations in regards to drug and alcohol testing, many other industries are not as heavily monitored despite also having many safety sensitive functions and positions. In one case, a forklift operator working in a warehouse caused destruction of property and threat of harm to other employees when he neglected to properly lift a pallet of product, causing the pallet to fall off of the forklift; in the post-accident testing, the employee tested positive for marijuana use (Workplace Impacts, n.d.). Though no one was injured in this accident, there is a potential for harm if incidents like this occur in other contexts. Operating heavy machinery under the influence of marijuana is unsafe, regardless of the type of machinery or the environment operating in. Although there is no specific regulatory agency overseeing warehousing or other areas of the supply chain, the Occupational Safety and Health Act of 1970 enacted by the U.S. Department of Labor's Occupational Safety and Health Administration (OSHA) requires all employers to "provide a workplace free from recognized hazards that are causing or likely to cause death or serious physical harm to his [or her] employees" (Calvasina, 2011). Ensuring employees performing safety sensitive jobs are not under the influence of illicit drugs is an important part of this mandate, even though testing for use it is not directly regulated.

As described in the examples above, marijuana use can cause serious impairment of the cognitive and physical ability of an employee, posing a huge risk to the safety of the employee themselves as well as other individuals. Many jobs in the supply chain industry involve operating heavy machinery that can cause serious physical harm in the case of an accident or crash. For this reason, it is particularly important for a company to regulate marijuana use by its employees working in these safety sensitive positions. However, it is also important to utilize current and future research findings on marijuana use to differentiate between the acute side effects of

marijuana use and long-term effects present even when not directly under the influence of the drug.

Testing Practices

In addition to the uncertainty regarding the nature of the physical and cognitive effects of marijuana on an individual, there is also a lot of ambiguity surrounding the testing to determine impairment. Unlike impairment due to alcohol use, which can be accurately measured using a Blood Alcohol Content (BAC) test, there is no reliable testing method to determine the level of impairment due to marijuana use (Urteaga, 2015). This presents a major issue for employers, as they are unable to accurately conduct post-accident drug testing to determine if an employee was under the influence at the time of the accident. The ambiguity with testing can be attributed to two main factors: the lack of reliability of testing methods and the weak link between THC metabolite levels and level of impairment.

One of the biggest issue employers face in regards to regulating marijuana use by its employees is the lack of reliable testing methods. While there are several options, each with their own benefits and disadvantages, some issues are common across all methods. The most common tests, urine, blood, hair, and saliva, each result in different timelines for peak THC levels in a user's system, none of which directly align with peak impairment. Additionally, a cutoff level for THC concentration for each testing method must be set by employers in attempt to achieve maximum accuracy (Workplace Drug Testing, n.d.). The goal is to reduce the number of false positives and false negatives through setting the cutoff at an appropriate level. Exhibit 5 shows

the possible results of a drug test, with employers seeking to minimize the number of results in

the lower right and upper left quadrants.

Exhibit 5 Drug Testing Results

Additionally, similar to the variability in the physical and cognitive effects of marijuana

on an individual, the specific properties of THC result in variance in the drug compound levels in

the user's system. These cannabinoid pharmacokinetics (the movement of the drug within the

body) involve the diverse routes of administration, different drug formulations and potencies,

metabolism by the individual's system, the frequency of use, and elimination in the urine, oral

fluid, and hair (Huestes, 2007). Employers are confronted with this issue in the timing of post-

accident testing. The majority of the testing methods are conducted in a formal lab setting as

opposed to on-site, such as the way breathalyzers are used to detect alcohol impairment

immediately after an accident occurs. In most cases of testing for driving under the influence of

marijuana or post-accident testing, specimens are usually not collected for one to four hours after

the incident and at an unknown amount of time after use (Biecheler et al., 2008). With the active

drug in marijuana passing through the body at inconsistent rates, it is difficult to determine

timing of usage and period of impairment an individual experienced through traditional post-

accident testing. Without information on individual's metabolism, timing and administration of

use, and history of usage, it is impossible to determine the level of drug concentration in the

system at the time of incident. Exhibit 6 provides a summary of issues related to testing of

marijuana use (Cary, 2006).

Exhibit 6 Factors Influencing Drug Testing Accuracy

Issue	Impact
Drug Dose	The higher the dose; the longer the detection window. The percentage of psychologically active delta-9 THC in marijuana plant material varies considerably, making dosage difficult to estimate.
Route of Entry	Inhalation versus oral consumption impacts processing.
Duration/ Frequency of Use	The longer the duration and the greater the frequency of cannabinoid usage (chronic); the greater the body storage of fat-soluble metabolites; the longer the cannabinoid detection window. Drug surveillance programs may be able to define use patterns based on client self-reporting, arrest reports, documentation of previous treatment, or other court records.
Metabolism Rate	The higher the metabolic functions of the client; the faster cannabinoids are broken down; the shorter the detection window. Monitoring programs cannot determine this parameter.
Test Sensitivity	The lower the cutoff concentration; the more sensitivity the testing method toward cannabinoids; the longer the detection window. Employer staff can select between various cannabinoid testing cutoffs.
Test Specificity	The less specific the testing method; the greater number of cannabinoid metabolites detected; the longer the detection window. This is difficult for monitoring programs to assess without technical assistance.

Testing Methods

Urine Testing

Urinalysis is the most common method for drug testing and is recognized by many

regulatory agencies, such as the DOT, as a reliable method (Mello, 2012). It is a popular method

because it is non-invasive, easy to collect specimens, and one of the more cost-effective methods

as the standards and processes are already established (Gips, 2006). However, there are some

limitations to the efficacy of urinalysis in detecting marijuana use.

Urine testing tends to indicate drug use in a relatively recent time frame, but is not an effective method for detecting acute usage. This limitation can be attributed to three reasons: (1) the characteristics of the drug metabolite tested, (2) the variable detection window, and (3) the inconsistencies between chronic versus infrequent use. Urine tests establish a likelihood of prior usage, but do not necessarily signify whether that use was in the past few hours, the past few days, or the past month (Mello, 2012). Though many research studies have been conducted to determine an accurate detection window for urinalysis tests, the only conclusion reached is that there is no standard timeline.

Urinalysis tests for the inactive drug metabolite THCCOOH, "which can be present for weeks after last use" (Phillips et al., 2015). This drug metabolite is understood to be made of lipid-soluble compounds that bind to "fat-containing structures within the body" (Baselt, 2004) for much longer than the active drug levels are causing impairment. This chemical characteristic of the drug as well as other attributes complicate testing, as the half-life for elimination of THC metabolites is particularly lengthy and also depends on an individual's metabolism. Detection times for cannabinoids "var[ies] considerably between subjects, even in controlled smoking studies using standardized dosing techniques" (Cary, 2006). The lipid-soluble cannabinoids tend to stay in the system much longer than other substances tested for through urinalysis (Cary, 2006). Additionally, the process of converting consumption of marijuana to THC metabolites is not immediate, leading to the window of detection starting several hours after consumption (Allen, 2011). This makes urinalysis an unreliable method to test acute usage and current impairment, therefore unreliable for post-accident testing.

Another complication caused by the chemical characteristics of THC is the variability in THC detection between chronic and infrequent users. Due to the long half-life of the THC

metabolites, chronic users build up cannabinoids in their systems faster than they are eliminated (Cary, 2006). This results in chronic users showing significant levels of THC in their urine despite potentially abstaining from the drug for multiple days or weeks. This can result in the chronic user potentially testing positive for marijuana when they are not currently impaired. If a chronic user were to consume marijuana at the same time and dose as an infrequent user, the levels of THC detected through a urine test would be much higher for the chronic user as they had a higher base level of the drug metabolites prior to acute usage. Conversely, an infrequent user may fall below the cutoff for detection despite currently being impaired.

Variability in the testing method combined with individual differences further aggravates the issue of lack of certainty regarding the timing of drug use and variability in detection window. The sensitivity of the test is based on the cutoff levels set by the employer. Typical cutoff levels are set at fifty nanograms per milliliter or twenty nanograms per milliliter. THC metabolites would be detected in a chronic user's urine for an estimated ten days and twenty-one days' post-use for the fifty nanograms per milliliter and twenty nanograms per milliliter cutoff levels, respectively. An infrequent user would test positive for approximately three to four days and seven days at the same cutoff levels. In either case, the individual recently consumed the drug, but the results would differ depending on both frequency of use and sensitivity of the urinalysis (Cary, 2006). Again, these general detection timeframes should be taken as a reasonable estimate with the understanding that the processing and elimination of cannabinoids varies greatly between individuals.

The limitations to conducting drug tests using a urinalysis method result in it being an effective test for pre-employment or for random testing for businesses with a zero-tolerance policy. Similarly, it is the preferred method for the DOT testing policies (Phillips et al., 2015), as

marijuana use is prohibited both on and off the job and therefore timing of use is

irrelevant. However, it is not an effective method for post-accident testing as it does not show

current or even probable acute impairment.

Blood Testing

Blood testing is generally considered the most accurate and effective method for

determining acute marijuana usage, albeit it is the most invasive and costly option as well. Blood

testing is typically reserved for legal purposes or post-accident testing (Gips, 2006).

One challenge with blood testing is that cannabinoid pharmacokinetics typically result in

the drug leaving the blood system fairly quickly (Gips, 2006). Inhalation of marijuana results in a

maximum THC levels in the blood within fifteen to thirty minutes post-consumption, but traces

of the drug are detectable in the blood for approximately two to three hours longer (Goldsmith et

al., 2012; Hartman et al., 2016). Due to the rapid processing and distribution of THC into tissue,

the user will likely feel the impairing effects of marijuana within minutes of inhalation (Baggio

et al., 2014). This rapid processing also results in a rapid decline of THC levels in the blood,

making the detection window very limited. This is a challenge for post-accident testing as blood

tests require specialized collection techniques and equipment for analysis, making it unfeasible

to do on-site or roadside testing (Lee et al., 2016).

As THC is detectable in the blood almost immediately after use, blood THC

concentration is "the most reliable objective cannabis exposure measure, with psychoactive THC

concentration best reflecting potential impairing effects" (Hartman et al., 2016). However, the

rapid processing can also be a challenge opposite to that of urine testing; the drug could have

already reached maximum concentration and been eliminated from the system prior to conducting post-accident testing. In fact, most measured concentrations in delayed collection result in "blood THC concentrations [that] are substantially lower than those present at the time of incident" (Hartman et al., 2016). Though a better option for detecting acute usage than some other methods, "peak effects do not coincide with maximum blood concentration" (Schwope et al., 2012). A study published by the National Institute on Drug Abuse (NIDA) Intramural Research Program showed that even though blood THC concentrations while driving were at levels that affected driving ability as measured in a National Advanced Driving Simulator, the levels reported in blood testing a few hours after consumption were below commonly used thresholds (Hartman et al., 2016).

For this reason, there is a lot of controversy regarding setting cutoff limits for blood THC concentrations for testing and determining impairment. There is much debate over what concentration of drug metabolites in the blood result in true impairment for an individual. Some states have addressed the issue through their legal limits to be considered driving under the influence of marijuana, with Washington and Colorado setting the limit at five nanograms per milliliter of blood (Armentano, 2013; Ingold, 2011). Other states, on the other hand, avoid the issue entirely and have set a zero-tolerance policy for impairment. These policies are mainly based off of traffic and post-accident studies, some reporting that blood THC levels of five nanograms per milliliter or higher increased the odds of a fatal crash over six times (Drummer et al., 2004).

Similar to urinalysis, blood tests also are impacted by the effects of chronic versus single or infrequent use of marijuana. In one clinical study, chronic marijuana users were evaluated through a period of abstinence to measure residual THCCOOH (the inactive metabolite) levels in

the blood. The results of this study showed "substantial whole blood THCCOOH concentrations persist multiple days after drug discontinuation in heavy chronic cannabis users" (Karscher et al., 2009). Blood levels were monitored in this study, but other tests for impairment were not conducted. To further highlight the irregularities of the way the human body processes marijuana, even though all twenty-five participants of the study identified as heavy, chronic users, some showed significant levels of drug metabolites in their system after seven days of abstinence while others did not (Karschner et al., 2009).

While blood testing is currently held as the best method for accurate post-accident testing, the rapid decrease of the drug in the blood renders blood testing yet another imperfect method. Even research publications supporting certain cutoff levels of THC concentration to measure impairment recommend that "THC levels should never be assessed in isolation - definable signs of impairment should also be present" (Phillips et al., 2015).

Hair Testing

Hair testing is the least costly and least invasive option for employers to test for marijuana use, but it also is the least informative method of testing (Mello, 2012). Hair follicles are surrounded by "a dense network of capillary blood vessels" (FAQ - Hair Testing, 2011), causing drug molecules in the blood stream to bind to hair as it grows from the scalp. The window of detection for hair tests ranges from five to ninety days. It takes approximately five days for the drug metabolites in the system to bond to the hair and reach the surface of the scalp. The molecules are detectable up to ninety days post drug use and can be even less if the individual has short hair (FAQ - Hair Testing, 2011).

Hair testing is most commonly used in pre-employment or random drug testing, as it is able to identify marijuana use any time within the past three months. Due to the delayed detection window from acute use, this method is not effective for post-incident or reasonable suspicion testing and is not accepted by most regulatory agencies to prove current or recent impairment (FAQ - Hair Testing, 2011).

Oral Fluid/Saliva Testing

Although not yet a fully developed and accepted method, researchers are working diligently to finalize a reliable oral fluid testing method for marijuana similar to a breathalyzer for alcohol. Police departments across the country are beginning to use the oral fluid tests as a roadside screening method for marijuana and other illicit drug use. Having a portable, fast, and reliable testing method available is beneficial to law enforcement agencies and businesses alike, as it combats the issue of delayed testing that is present in blood and urine testing. If the technology continues to progress, oral fluid testing could potentially become the standard for testing for acute usage and impairment. The advantages of saliva testing include the ease of sample collection and processing, timely assessment and results, difficulty of adulterating specimens, and a close relationship between acute use and level of impairment (Bosker et al., 2012). Previous attempts at developing an accurate oral fluid testing method resulted in issues with developing a small-scale, portable technology that was sensitive enough to "detect trace amounts of THC in oral fluids" (Lee et al., 2016), but many researchers are finding support for the accuracy of their latest technologies.

Current developments estimate the window of detection for saliva analysis to be start immediately after consumption and continue up to two hours post use (Himes et al., 2013). Though there is limited conclusive research, initial findings estimate the cutoff concentration of THC should be in the range of two to twenty-five nanograms per milliliter (Van der Linden et al., 2015). The main issue is that "on-site screening… test tools are not sensitive enough to detect THC with the proposed ranges of cutoffs" (Verstraete, 2005). However, recent developments in testing devices seem to effectively be overcoming this limitation.

One of the leading testing devices in the developing industry is the Dräger DrugTest 5000. This device uses oral fluids to test for the presence of "psychoactive components from seven of the most commonly abused drug types, including cannabinoids (THC)" (Varec, 2016). The Dräger DrugTest is being implemented in law enforcement agency testing in select states across the U.S. This method has been rigorously tested and has proved scientific validity, but it is still taking time to spread into common use. Perhaps the most significant sign of progress for the legitimate use of oral fluid testing is the acceptance of results from the Dräger DT5000 as evidence in a California Court. In the case of the People of the State of California v. Junior Salas, the jury found the defendant guilty of vehicular manslaughter following review of drug testing results processed by the Dräger device. This decision is "the first scientific-reliability ruling for a device of this kind in the U.S." (Varec, 2016), serving as a "landmark case for the use of admissible oral fluid drug test results in the court of law" (Varec, 2016). This case lays the foundation for saliva testing to become the standard screening method for driving under the influence of drugs investigations. As the Dräger test and other oral fluid tests become more widely accepted as reliable and effective, businesses can take advantage of the technology in

their post-accident and probable cause testing. Oral fluid testing has many benefits and will allow employers to get a better idea of current impairment than other methods.

Other technologies are also in the process of being developed that will lead to greater accuracy of small molecule detection and thus acute level of impairment. One group of researchers is developing a testing device that utilizes "giant magnetoresistive (GMR) biosensors integrated with a portable reader system and smartphone to detect THC in saliva using competitive assays," allowing for the accurate "measure [of] THC in the range from zero to fifty ng/mL, covering most cutoff values proposed in previous studies" (Lee et al., 2016). This advanced technology will allow law enforcement and employers the opportunity to set their cutoff level at a lower level than previous methods allowed so they are able to able to better detect trace levels of THC. This device would also be effective to use in post-accident testing to get an immediate, accurate measure of THC levels in the saliva. This testing method is still in the preliminary testing stages, but it shows the potential for rapid advancement of technology in the field of oral fluid drug testing.

As the technology is still developing, oral fluid testing may be useful as a screening method to determine if a blood test might be needed to confirm marijuana use (Anizan et al., 2013). Eventually, the oral fluid test may be used as the sole test for detecting marijuana use and impairment levels. Preliminary evidence supports that the concentration THC in saliva may be more closely related to actual impairment than THC levels measured in urine or blood (Ramaekers et al., 2006). Once the reliability of oral fluid testing becomes more widely accepted, the noninvasive, rapid measurement method may become the preferred method for on-site testing (Lee et al., 2016).

Relationship Between THC Levels and Impairment

Even though it is clear that marijuana use, and therefore presence of THC in the system, impairs a user's cognitive and psychomotor abilities, there is no scientific consensus as to what specific level of THC concentration causes significant impairment (Allen, 2011; Ramaekers et al., 2006). Testing methods are becoming more reliable and are able to measure specific levels of THC concentration, but these advancements are not useful without gaining a better understanding of how to interpret them. As stated previously, concentration of THC in an individual's blood, saliva, or urine shows that an individual has used marijuana at some point during the detection window for the specific testing method, but does not directly relate to a specific level of impairment. In fact, "it is difficult, if not impossible, to establish a relationship between a person's THC concentration and performance impairing effects" (Goldsmith et al., 2012). This relationship, or lack thereof, is once again attributed to individual differences, the inconsistent processing of the drug metabolites, and the chemical characteristics of the drug.

Individual differences in metabolism, processing, and frequency of use may result in varying levels of impairment despite similar consumption and concentration of THC. An individual with a fast metabolism may process THC compounds quickly, facilitating the transfer from concentration in the blood stream to urine, while still experiencing the full effects of the amount of marijuana consumed. Another individual may be experiencing the same level of impairment, but the processing speed could be slower. Conducting a blood test on these individuals would result in different levels of THC concentration despite similar consumption and impairment experienced (Huestes, 2007). Similarly, impaired behavior from marijuana use differs between occasional and frequent users, regardless of THC levels measured. Chronic users tend to have a higher "tolerance" for the drug metabolites in their system, leading to less

symptoms of observable impairment than non-frequent users (Theunissen et al., 2012; Ramaekers et al., 2009). This effect has been reported in alcohol use as well, with chronic drinkers showing less apparent intoxication than a naive drinker at a given BAC (Phillips et al., 2015). The differences in observable impairment between individuals with similar THC levels support the idea that THC concentrations do not directly relate to level of impairment.

Additionally, it is possible for individuals to test positive for THC in a urine test despite not currently being impaired. Due to the chemical characteristics of THC described in the previous sections, marijuana use results in residual inactive metabolites stored in fatty substances in the body because of its lipid-soluble nature. These residual metabolites can be detected in urinalysis and sometimes are measured above the standard cutoff for "impairment" despite no recent consumption of the drug. This is particularly true for chronic users. Blood tests, on the other hand, may be subject to frequent false negative results. THC concentrations decrease rapidly from the blood after consumption, much faster than the physical and cognitive effects of marijuana decrease for the user (Karscher et al., 2009). Clearly, it is an issue for an individual to be observably impaired by marijuana use yet test negative for THC metabolites because they have already left the blood stream.

For alcohol impairment, specific BAC ranges are linked to specific levels of impairment, including presence and severity of symptoms such as reduced cognitive functioning and vomiting. Alcohol displays "comparatively slow and consistent zero-order elimination kinetics" (Jones, 2010), meaning it leaves an individual's system at a constant rate, unlike THC. The chemical properties of alcohol and how it is processed by the body allow for those established relationships between BAC and level of impairment. Generally, the more alcohol an individual drinks, the higher their BAC, the more impaired they are (Ferner, 2013). While there are

differences between individuals in how they are affected by alcohol, it is nowhere near the variability seen in the processing and subsequent impairment by marijuana use.

Although some states have set per se driving laws with a concrete cutoff level that is used to determine impairment, there is still much debate on the accuracy and reliability of the levels chosen. In 2011, Colorado's Marijuana DUI Workgroup approached the state drug policy task force responsible for regulating the legalization of marijuana, claiming that "a five-ng per se law would be unnecessary, unsupported by the science, and unlikely to significantly improve public safety" (Elliott & Smith, 2011). There is some evidence to suggest that individuals testing above the cutoff level for cannabinoid concentration have increased risk of impairment, but the specific level chosen seems to be somewhat arbitrary. Blood THC level of five nanograms per milliliter is "generally accepted as the legal limit for motor vehicle operation in states where marijuana is legal" (Goldsmith et al., 2012). Although blood testing plays a large role in the prosecution of an individual for driving under the influence, Colorado law enforcement also base arrests on observed signs of impairment (FAQs: Cannabis and Driving, n.d.). Both businesses engaging in employee drug testing and law enforcement agencies typically recommend pairing any form of drug test with a cognitive or physical test to identify acute impairment.

Ultimately, a positive test for marijuana, even above the cutoff THC concentration level, does not confirm acute usage or level of impairment for an individual. These cutoffs may be valuable in establishing an "initial presumption of impairment," however, "the mere presence of... THC and THCCOOH levels may not establish acute impairment in an individual" (Phillips et al., 2015). Concentration of THC in an individual's system must be used in combination with other evaluations of physical and cognitive symptoms in order to accurately determine level of impairment.

Current Business Responses

As the progression of the legalization of marijuana continues, businesses have already had to make decisions on how they will manage their policies. This legislation has many implications on the human resource policies of a business, including drug policy and testing, equal opportunity and employment practices, and recruitment and retention of employees (Pastore et al., 2013). The most important move to be made by businesses is to develop a drug policy that complies with legal regulations and ensures a safe working environment as well as is acceptable to employees and will allow for the maximum levels of talent and productivity (Truxillo et al., 2013).

Many of the opportunities available in the supply chain industry that are considered safety sensitive also experience issues with recruitment and retention of employees. In 2014, the commercial trucking industry experienced a shortage of over 38,000 drivers, and the shortage has continued to grow over the past couple of years (Costello & Suarez, 2015). Similarly, the U.S. Merchant Marine industry is experiencing a shortage of qualified employees, needing over 70,000 new people to join the maritime fleet by 2020, but expecting to graduate less than 10,000 people from the preparation academies (Grady, 2016). Many other industries are experiencing similar shortages as well. Much of the shortages can be attributed to low pay rates, physically demanding work and challenging lifestyle, and changing demographics of the labor pool. While these reasons are unrelated to drug policy, restrictions involving use of drugs or alcohol outside of work may further perpetuate the shortage of employees. As Pastore and colleagues (2013) explained in their analysis, "employers could be losing good employees who are sufficient performers or good applicants who won't pose safety risks while at work if they enact a 'zero-tolerance' drug policy, whether regarding medicinal use or recreational use of marijuana."

Individuals may be hesitant to seek employment in these positions for the reasons listed

previously and further unwilling due to having to comply with restrictions placed on their rights

to engage in legally using marijuana during non-working hours. Vice President of the Labor and

Employment Group at Ice Miller Legal Counsel, Paul Bittner, shared that some companies he

consults for are "considering abandoning pre-employment drug screening because [they]

couldn't recruit enough employees" as "too many prospective employees tested positive for

THC" (Workplace Impacts, n.d.). While maintaining safety is a priority for the supply chain

industry due to the safety risks involved, it is also important that there are enough workers

available for a business to maintain their operations.

Despite the issues with recruitment of employees for certain business functions, most

companies are keeping their zero-tolerance policies for marijuana use. Many individuals living in

states where marijuana is being legalized for medical or recreational use believe that they have a

so called "free pass" to indulge in use of the drug; however, private companies have the right to

terminate employees for marijuana use. Businesses are permitted to enforce these drug policies

because marijuana is still illegal under federal law, regardless of state legislation. The purpose of

the legalization of marijuana in states was held in court to protect citizens from arrest and

prosecution for drug use rather than to impose any regulation on private businesses (Workplace

Impacts, n.d.). In the case of Casias v. Wal-Mart Stores, the Sixth Circuit Court decided that

Wal-Mart was not acting unlawfully for firing an inventory control manager in a Michigan store

for using medical marijuana for cancer pain management (Swanton, 2013). Casias tested positive

for THC at a visit to the hospital for injuring his knee at work (Workplace Impacts, n.d.).

Regardless of the fact that the injury was not related to an accident caused by drug impairment

and that Casias was not currently under the influence of marijuana, Wal-Mart was able to legally

terminate his employment for testing positive. The Casias v. Wal-Mart case is a good example of an individual who was considered a productive employee, even being named Associate of the Year for the store, and had no safety violations putting himself or others at risk, but was fired for engaging in marijuana use outside of work (Pastore et al., 2013). Wal-Mart may have intended this action to be for the purpose of ensuring safety in the workplace, but instead they are losing an exceptional worker for reasons that did not directly affect the individual's work ethic or performance. This judicial decision has been upheld in every state where a case has reached the state supreme court, including California, Washington, Oregon, and Montana (Swanton, 2013).

Despite the absolute power of federal law over state law, some states have passed legislation stating that employers cannot discriminate against employees for being qualified to use or for actually using marijuana for medical reasons. Arizona, Delaware, and Minnesota have laws in place to protect employees from termination for testing positive for marijuana use if they have appropriate medical registration, and other states have mandates that require employers to make reasonable accommodations for employees using medical marijuana (Ariz. Rv. State. Ann; Del. Code. Ann. Tit. 16; Minn. Stat. Ann; Pinsker, 2015). However, the U.S. Court of Appeals for the Ninth Circuit ruled that medical marijuana use is not protected under the federal Americans with Disabilities Act (ADA) (Urteaga, 2015). The ADA mandates that employers make reasonable accommodations for qualified disabled candidates. Some argue that allowing employees to treat pain or other symptoms with marijuana use outside of work should be considered reasonable accommodation, but due to federal law superseding state law, courts have not backed that opinion. In Ross v. Ragingwire Telecommunications (2008), the plaintiff claimed that Ragingwire violated the ADA by firing him for use of medical marijuana as treatment for his disability. The lower courts and all levels of appellate courts held that medical

marijuana use was not protected under the ADA because the law includes an exclusion for protection of "any employee or applicant who is currently engag[ed] in the illegal use of drugs" (Americans with Disabilities Act), which technically includes marijuana. Therefore, it is appropriate for a company to discipline or terminate an employee for marijuana use, regardless of the timing or reasoning for use.

As companies evaluate their current drug policies in relation to various state and federal legislation, they are often deciding to simply maintain a zero-tolerance policy towards marijuana use. As evidenced by the differing levels of regulation and protection in different states, there is "an unbelievable administrative headache for multistate employers" (Nagele-Piazza, 2016). It is easiest to create a uniform code across all areas of operation for a company, as it is clear to employees what the expectations and consequences are regarding drug use. Given a clear, consistent policy, employees would have a "high burden of proof to show that they were the victims of discrimination or wrongful termination should they violate the policy" (Pastore et al., 2013). A consistent zero-tolerance policy avoids the complexities of differentiating between medical and recreational use of marijuana and between use by employees in safety sensitive jobs and those in less risky jobs. Some companies have decided to make adjustments on a state-by-state basis to allow exceptions for medical use as to avoid any risk of litigation under state law even though most jurisdictions that have faced this issue sided in favor of federal law superiority (Nagele-Piazza, 2016). Very few businesses across the country have removed policies regarding marijuana use completely from their human resource management.

Chapter 5

Final Recommendations

There is clearly still much uncertainty and ambiguity in regards to the legalization of marijuana and its impact on businesses. Many supply chain organizations are facing issues recruiting and retaining employees within their business unit, and placing further restrictions on these employees could aggravate the issue. However, the general consensus is that the progression of the legalization of marijuana is outpacing the research and technology needed to manage it. Testing methods are still unreliable in detecting acute usage, and even as testing technology improves, there is no evidence that supports a direct connection between presence of drug metabolites and level of impairment for an individual. For these reasons, it is recommended that employers continue to hold a zero-tolerance policy for marijuana use. Having a zero-tolerance policy as a consistent standard across the organization is a clear policy for employees to understand and will likely prevent any claims of discrimination. If any legal issues do arise, the legality of discipline or termination of employment in response to testing positive for marijuana use has been backed by every court that has addressed the issue and will likely be supported in other jurisdictions as well.

By maintaining a zero-tolerance policy for marijuana use, employers may experience personnel issues with filling some of the less desirable positions, but the risk of accident or fatality due to an impaired employee is too great of a risk to allow. Many positions in the supply chain industry involve operating heavy machinery, such as forklifts or trucks, which have the

potential to cause harm if not operated properly. While employers are required to maintain strict

drug testing requirements for transportation providers, the other segments are less regulated

despite being just as safety sensitive. Companies should place the same regulations on all

employees to strengthen the understanding and presence of their drug policies as well as to

ensure a safe working environment in areas that are not strictly covered by federal government

agencies.

As research institutions, government agencies, and other companies sort through the

many issues discussed, companies may consider reevaluating their drug and alcohol policies

once more. The tradeoff between safety and opportunity is still very much present, and the

prioritization may be switched to the side of opportunity as the risks become better understood

and managed. Eventually, it is predicted that the "laws will catch up with the culture, and

increasingly, employers are not going to want to fire employees for marijuana use off the job and

then go through the process of hiring and training;" in other words, "they will treat marijuana

similarly to how they treat alcohol" (Pinsker, 2015). In the meantime, employers may consider

using alternative methods to account for safety of employees while still addressing some of the

other issues present.

General Impairment Testing

Maintaining a zero-tolerance policy for marijuana use is a safe, legally sound move for

employers to make while the many issues regarding testing and research are resolved. However,

there are possible alternatives that may better address both sides of the issue for employers. One

concept growing in popularity is the testing of individuals for general impairment rather than

trying to attribute it to a specific cause. The idea is that regardless of why an individual is impaired, if that person is experiencing limited cognitive processing, slowed reaction times, and impaired dexterity, they are unfit to be performing certain activities, particularly if they pose a safety risk. According to Lori Birk, Vice President for the Mountain State Employers Council and a lawyer licensed in three states, some companies are already switching to the practice of paying attention to "outward signs of whether someone is impaired at work" (Smith, 2016) as opposed to specifically testing for marijuana.

Dr. Igor Grant, chairman of the department of psychiatry at UC San Diego and department head for UC's Center for Medicinal Cannabis Research, says that testing for impairment should be focused on physical evaluations on coordination, perception, reaction times, and attention rather than chemicals in the system (Bebinger, 2016). He believes that "at the end of the day, what counts is, are you actually impaired, not whether you've had exposure to something" (Bebinger, 2016). Dr. Grant's thoughts on impairment are actually quite accurate; there are many factors besides illicit drugs or alcohol that could lead to impaired and unsafe operating of vehicles or machinery. For instance, some studies have reported that "drowsy driving," or driving while tired or fatigued, can be just as dangerous as drunk driving. In fact, the National Highway Traffic Safety Administration reported that in 2014, over sixteen percent of all fatal crashes involved drowsy driving (NHTSA Drowsy Driving, n.d.). These accidents resulted in over 1,500 deaths, 71,000 injuries, and 12.5 billion dollars in financial loss (Facts and Stats, n.d.). Driving while drowsy slows reaction time, decreases awareness, and impairs judgement, which are many of the reasons risk of crashing is increased when driving under the influence of illicit drugs and alcohol.

Other factors could produce similar effects as well, such as over-the-counter or prescription medications being taken lawfully. Many prescription medications come with a major list of side effects including ones that could lead to impairment. The Center for Disease Control and Prevention (2004) reports that half of all Americans use at least one prescription drug at any given time. The majority of these drugs are not tested for in a drug test, despite many coming with warnings about drowsiness or recommendations to not operate heavy machinery. Testing for general impairment may be effective in further reducing risk of performing safety sensitive tasks while impaired as it has the potential to identify unsafe operating conditions that are not currently controlled for.

One researcher is attempting to develop a method for general impairment testing. Michael Milburn from the University of Massachusetts Boston has developed a mobile application to detect impairment of an individual in comparison to their baseline testing (Young Yoo, 2016). The app, named DRUID (Driving Under the Influence of Drugs), requires participants to perform a series of tasks over five minutes measuring reaction time, attention, and balance (Smith, 2017). The test requires individuals to balance on one leg while holding the mobile device, track a shape moving across the screen with your finger, and tap on certain shapes while simultaneously keeping track of time passing (Young Yoo, 2016). Following completion of the test, the application compares test results to baseline measures to return a level of impairment for an individual and recommendation on the safety of driving a vehicle. While this application based test is still in development and no peer-reviewed studies have been published regarding the reliability of it, it shows promise to convenient and accurate means of testing impairment outside of testing for chemicals in an individual's system. Milburn has conducted

preliminary testing with the results of the impairment test aligning closely with the typical rise

and fall of impairment after consuming marijuana (Young Yoo, 2016).

The methodology behind this application based test mirrors the field tests conducted by

police to detect driving under the influence of marijuana. Common procedure in Massachusetts

to test for driving under the influence of drugs is to have the individual in question complete a

twelve step test conducted by a trained and qualified drug recognition expert (DRE) (Bebinger,

2016). The test is performed at the police station and takes over an hour, including measuring

physiological symptoms as well as balance and coordination (Bebinger, 2016). While DREs

conducting and evaluating this test are specially trained and are typically very accurate, it is often

not accepted as a sole measure proving impairment as it is based on a subjective evaluation.

Application based tests show potential for replacing the standard testing conducted by a

DRE, as it can be conducted roadside to evaluate current impairment (as opposed to delayed due

to transit time to the police station) and results in an objective measure of impairment. Currently,

police have few alternatives, as "they do not yet have reliable roadside toxicology tests that can

say for sure if someone's too high to drive in the way a breathalyzer or blood test can show if

someone's too drunk" (Smith, 2017). Apps such as DRUID and other general impairment tests

could be the future of impairment testing.

Employers are in a similar position in terms of limitations on testing. As discussed

previously, post-accident drug testing is typically not a reliable method for determining whether

the employee was under the influence of drugs at the time of the incident, as the testing is

typically conducted long after the peak of impairment has passed, and cannabinoid levels do not

prove impairment at the time of the accident. Employers could potentially conduct a general

impairment test immediately after the incident occurs to determine the level of impairment and

follow it up with a traditional drug test to confirm use. This two-step method would confirm both that the employee was determined to be impaired at the time of the accident as well as that they have used illicit drugs relatively recently. The combination of both forms of testing would allow employers to draw reasonable conclusions about the level and cause of impairment of the employee.

Furthermore, this application based impairment testing could be used to prevent incidents in addition to identifying probable cause in post-accident testing. Employees in safety sensitive positions could be required to complete the impairment test prior to beginning the task in question, whether that is starting their driving route or operating a forklift, to ensure they have the mental and physical capability to perform safely and effectively. While this process would take valuable time out of the workers' days, the benefits of avoiding deadly or costly accidents greatly outweigh the downfalls. Employees would be able to self-assess in order to confirm safety of proceeding with the task.

While the technology is still in the development stage, general impairment testing could be a good option for employers to consider, as it would allow them to avoid some of the disadvantages of a zero-tolerance policy while still maintaining a high standard for safety. Without restrictive drug policies, employers may be able to combat some of the recruitment and retention issues they are experiencing. So long as an individual is able to be productive and safely perform all job responsibilities, their behavior outside of working hours would not be a limiting factor. Employees will appreciate the fairness of the policy; only those who cause significant bodily harm or costly damage will be under scrutiny. Additionally, an employer may be able avoid costly litigation resulting from claims of discrimination. Even though the courts have shown to side with the employer in claims of discrimination of employees using marijuana

for medical reasons, it can still cost an employer between $50,000 and $100,000 in attorney's fees to dismisses an ADA claim in court (Sharing the Dream, 2000). Most importantly, regular, simple pre-screenings for impairment prior to conducting a safety sensitive task promotes safety and well-being for the individual themselves as well as other workers and the general public.

Conclusion

The legalization of marijuana occurring at the state level presents a variety of issues for supply chain organizations. Restrictive policies regarding drug use perpetuate the worker shortage many of these companies are experiencing, but the same policies also ensure the companies are providing a safe working environment for their employees and complying with government regulations. The issue of how to address drug policies is further complicated by the research on the effects and testing of marijuana use. Because of the uncertainty regarding the level of impairment following marijuana use and the unreliability of current testing methods, it is recommended that companies continue to approach drug testing with a zero-tolerance policy towards marijuana use. Prohibiting marijuana use by employees is consistent with and protected under federal legislation and avoids many of the issues and complexities involved in the management and testing for marijuana use in employees. As research on marijuana use and development of improved testing methods continues to progress, companies may consider reevaluating their policies. Some viable options for companies to be aware of and consider as they are more fully developed include using oral fluid testing to test for acute marijuana use and impairment as well as general impairment testing.

Appendix A

Interview Guide – Legalization of Marijuana

1. What are your current procedures for drug and alcohol testing? When are tests administered and what testing methods are used (i.e. analysis of urine, blood, hair, etc.)?

2. What is your corporate policy on drug or alcohol use? Is it the same across all business units and geographical areas?

    a. Does your policy have caveats for use of prescription drugs?

3. Do you have any statistics available on accident rates and causes they were attributed to?

4. Which, if any, governmental regulations are most relevant to your business in terms of safety regulations?

5. Have you experienced any issues filling positions in your supply chain department, particularly ones that are considered "safety sensitive" such as forklift operators or truck drivers?

6. Has the legalization of marijuana been recognized as a topic of concern for your company?

    a. If so, what issues have been discussed? What do you consider to be the main areas of concern?
    b. Are there any plans or initiatives in place to address any of these issues?

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