~~Literature Review:~~ Hazmat Transportation

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**Introduction**

 The transport of hazardous materials (hazmat)is an issue that requires highly trained individuals with an understanding of the importance of safety during freight. Depending on the classification of the materials and their destination, a variety of procedures are used to ascertain safety. There are numerous stakeholders in the transportation of hazmat, which include the health of the people, loss of lives, the environment, and the lives of other living organisms. It is, therefore, of utmost importance to focus on the safety of the materials in transit to ensure they reach their destination intact. The following literature review discusses the transportation of hazmat in addition to providing ways of increasing safety while they are in transit.

**Safety**

**Training**

           Safety is of the utmost importance during the transportation of hazmat. Bengler and Jiang (2016) found training on safety procedures reduces chances of incidences. However, the investors involved have to place importance on training and provide the requirements for its facilitation. The fact that exposure to hazmat has massive adverse impacts on people, animals, and the environment necessitates the need for all the investments geared towards ensuring the safety of all the stakeholders (Bengler & Jiang, 2016). Training is one of the strategies that ensure employees understand the category of hazmat and thus the means of its handling.

           Training also plays a significant role in protecting the process of receiving and offering hazmat. In this way, the employees involved will have the ability to move the materials from point A to B without exposure (Bengler & Jiang, 2016). Highly trained employees are thus an asset in the process of hazmat transportation.

**Responsibilities**

The transportation of hazmat is a process that has specific roles and responsibilities that they reach their destination. Verma, Verter, and Zufferey (2012) concluded that hazardous materials are categorized into divisions including flammable, explosive, and infectious. Under these categories, employees have specific responsibilities that ensure the materials get to their destinations. Outlining the duties for the involved staff allows them to develop particular skills that smooth the journey. Additionally, Verma et al. (2012) argue that dividing the roles of the transportation process enhances safety. However, for these responsibilities to work together to protect the materials, there is a dire need for an easy communication system. The staff mandated with loading, for instance, have to communicate effectively with the ones in the office to confirm loading. More so, all the checkpoints have to confirm the safe passage of the materials.

**Security Assessment**

           A clearly defined procedure is of utmost importance in the safety of hazmat transportation. According to Xie, Lu, Wang, and Quadrifoglio (2012), a procedure provides employees with a reliable way of ensuring the process is on course. Additionally, all people involved are aware of what is expected of them and thus, are can effectively perform their duties. ~~From research conducted by~~ Xie et al. (2012) confirmed that check-up points throughout the journey are an essential part of the safety procedure. In a majority of these check-up points, there are systems set up that ensure the cargo is on time, and the safety measures are in place. Additionally, the check-up points have the necessary means to avert a threat. In the process, the staff at the check-up points have the required skills and equipment to contain any incidents. Therefore, they also require the know how to assess whether or not the situation with the material in transit is safe.

**Transport**

**Procedure**

           Hazmat transportation is a process that is procedural with several aspects that are required to ascertain the safety of the cargo. Therefore, packaging is one of the issues that is of great importance to the process. According to Assadipour, Ke, and Verma (2015), the packaging of hazardous materials depends on the category to which it belongs. During the packaging stage of the material, all involved employees have to understand how to handle a particular type of cargo to ensure the safety of all people involved. ~~In their research,~~ Assadipour et al. (2015) concluded hazmat requires labeling, especially showing the dangerous aspects of the contents. In the process, employees will exercise caution while transporting the product. Additionally, the packaging of the product depends on the destination. For instance, materials shipped by air are packed differently from those being moved by ship. Also, other logistics such as weight and bulkiness are of great importance while deciding on the type of packaging to use.

**Mode**

           The mode used to transport hazmat is of great importance to its safety. Saat, Werth, Schaeffer, and Yoon (2014) suggest an in-depth understanding of the contents of the materials is of great importance in deciding the mode of transport to use. For instance, some materials become explosive under pressure, and thus air transport is not appropriate. In other cases, it is better to transport materials in liquid form as it is faster and reduces chances of incidence. However, a variety of issues require consideration as the mode of transport has a direct impact on the safety of products during the journey (Saat et al., 2014). Additionally, the classification of the material is of great importance to the mode of transport. Therefore, depending on the volatility, urgency, and classification of the materials, a company decides how to pick the most appropriate mode. Notably, with regards to cost, a majority of companies handling hazmat settle on the safest method irrespective of the charges.

**Classification**

           Classification of hazardous materials, according to Leal and D’Agosto (2011), provides stakeholders with the necessary information to transport it safely. The classifications include flammable gases and liquids, oxidizing substances, explosives, flammable solids, and corrosives. Once the materials are classified according to their toxicity, the involved staff have the necessary information to make informed decisions on the appropriate mode of transport. Additionally, the classifications allow the employees to take essential training depending on the class of hazmat handled. The classes play a significant role in reducing incidences as well. With well-labeled packaging of the materials, there is ample opportunity for stakeholders to take the necessary action in case of exposure (Leal & D’Agosto, 2011). Classification therefore is a critical part of the transportation of hazmat as it is the basis of a significant amount of decisions regarding mode and safety measures to be applied while in-transit. Classification is also part of regulations stipulated by authorities to ensure compliance with safety measures set up by the governments.

**Loading and Offloading**

           A keen analysis of the situation indicates that the loading and offloading processes of moving hazmat from point A to B is of critical importance. To ensure the transit of the materials is safe, the loading and the offloading stages must consider the classification as well. ~~From research on the issue,~~ Liu, Saat, and Barken (2013) agree specific training for loading and offloading is of great importance. Additionally, these stages set the precedence for the entire journey of the materials. Notably, moving them is part of the procedure that involves the handling of the hazmat. Therefore, employees loading and offloading the materials require specialized training that will provide them with the necessary skills to handle the demands of each stage. Additionally, such employees need having experience in the field to ensure they note any instability with the product prior to and after delivery. In this way, they will have the ability to avert danger.

**Enhancing Safety**

**Regular Training**

           As noted earlier, the transportation of hazmat is a process that requires highly trained individuals. The basis of the training is to provide employees with specific skills to ensure they are prepared to handle the volatility of the materials. However, Jassbi and Makvandi (2010) found there is a need for regular training. In the process, involved employees have an opportunity of learning new technological ways of handling incidences of hazmat while in transit. Irrespective of the costs involved in such a strategy, companies require training their employees regularly to ensure they understand newly developed ways of handling hazmat while in transit (Jassbi & Makvandi, 2010). More so, the training introduces employees to people in the industry an issue that has the potential of expanding their attitude towards the safety of hazmat. In the process, employees become better prepared for any incidences, an issue that is of great importance to the protection of all involved players.

**Insurance**

           Insurance is a security aspect of the transportation business. However, with regards to hazmat, the issue is critical as the stakes involved are incredibly high. Therefore, research into the matter indicates that irrespective of the costs involved companies take out insurance covers for the cargo in transit (Ma, Li, He, & Duan, 2012). Notably, some companies take a variety of insurance coverage to ensure they are adequately protected in case of an incidence. The costs involved, however, are part of the transportation of the materials and thus not viewed as an expense. Irrespective of the massive safety procedures and precautions taking during the transportation stage, some exposures do take place. Consequently, with several insurance coverages, the involved companies can pay off the damages without going bankrupt. The insurance coverage provide the companies involved with a form of security while transporting the materials. In this way, the organizations can comfortably move more hazmat.

**Back up Plans**

           The transportation of hazmat is a precarious process that requires extreme caution. The fact the materials have the potential of leading to loss of lives worsens the situation. Therefore, having back-up plans for handling emergencies is part of any additional safety procedures. Das, Mazumder, and Gupta (2012) suggest companies ought to have backup plans in case of incidences. For instance, if flammable liquids were being transported from one area to the next through a pipeline, a company should have an alternative mode of transport waiting. During the change of transportation mode, there is a need for highly qualified individuals who could successfully make the changes without leading to exposure. The backup plans are necessary as there are times when the current plans used might fail. Additionally, the hazmat, in most instances, have several other stages they have to go through before their final level.

**Technology**

           Technology in the 21st century provides organizations with an ability to change their mode of transport of hazmat easily. More so, technology has allowed for an in-depth understanding of the impacts of exposure and thus, led to better ways to maintain safety. Liu et al. (2014) note technology has the potential of improving the current modes used in the transportation of the hazmat. Therefore, technology is an integral part of shipping, and thus, companies should find means of synchronizing it with the type of transportation used. An analysis of technology indicates technology also provides organizations with better ways of monitoring the materials while in-transit. In this way, all people involved have real-time information on the materials as they move along the itinerary. In the end, technology provides the organization with a form of enhancing security for the materials. However, for technology to become an effective method of improving safety, there is a need for a regular training to enhance the employees’ skills.

**Compliance with the Law**

           Transporting hazmat, especially across matters, is an issue that involves a variety of laws. The laws are designated to protect the interests of people as they are the first victims of exposures. Additionally, the aim is to conserve the environment in light of the potential dangers the materials have on the environment. The Hazardous Materials Regulations (HMR), for instance, is a regulation with which organizations transporting hazmat have to comply (Rapik & Barken ~~et al.,~~ 2011). The rules, in most situations, focus on the security of the packages, the information provided to the public, the safety procedures in place in case of an incidence, and the final destination of the materials. In this way, the law ascertains the safety of the materials in transit. A keen analysis of the situation indicates there are more rule and regulations volatile products have to comply with compared to milder materials. Therefore, the laws are meant to ensure organizations place importance on the safety of the materials in transit.

**The Use**

           As noted earlier, transportation is part of the stages hazmat has to go through. There are rules and regulations set explicitly for hazmat that are waste materials and those that are raw materials. In most instances, organizations are extremely cautious of raw materials as they are part of their production chains (Gupta, Das, & Mazumder, 2012). However, the situation is different if the materials are waste products. Dumping is an issue that has negatively impacted the environment and led to increased non-communicable diseases. It is the waste products that a majority of government regulations control. Notably, the rules also have to ensure the products are transported by means that are considerate of the environment, the lives of the people and animals, and property. Regardless of the use of the materials, safety is an issue that attracts the attention of relevant authorities to ensure the prioritizing of other factors. The incidences that have occurred in the past involving the transportation of hazmat has been a result of negligence, and the law has ensured appropriate compensation is made. In the process, people have placed importance on safety in the transportation process of their hazmat, a matter that has increasingly reduced the occurrences of accidents.

**Exposure**

           The safety regulations used throughout the transportation of hazmat from point A to B are geared to eliminate incidences of exposures. The materials have a variety of ways they react when exposed to air, for instance. However, as a result of negligence or equipment failure, there are cases of exposures. It is at this level that organizations take responsibility for their participation in the accident. Raemdonck, Macharis, and Mairesse (2013) note the strategies set up by organizations to handle incidences should be tested regularly to ensure they are working. In this way, the organization will have the opportunity of containing the situation before it worsens. Additionally, organizations should have medical professionals and environmentalists with the required skills to prevent loss of lives. Therefore, in case of an incidence, the organization involved should provide the necessary information to the medical personnel on the ground, for example, on the best way of preventing further damage.

**Emergency Response**

           The transportation of hazmat is a process that requires the existence of relevant information. The cargo should have contact data in case there is a breakdown midway. The data should also provide the public with the caution of what to do in case of an emergency. Ardymand Young, and Weckman (2016) are of the idea that emergency response should focus on a variety of issues that have a direct correlation with the public. The organizations transporting the material have the responsibility of ensuring that there is minimal exposure of the product to the public. Therefore, through a variety of strategies such as monitoring and assessment, the organization can develop the relevant strategies of managing the situation. Additionally, the approach must ensure the safely reach their destination (Ardymand et al., 2016). Once an incidence occurs the packaging of the materials should have the information on the next step to take. In case, officials are not available at the scene on time, and the information will direct the public on what to do as first-aid to avoid further damage. In this way, the public will be active in the emergency response and assist in controlling the damage.

**Conclusion**

           Transportation of hazmat is a process that requires absolute caution as it has the potential of leading to a loss of lives of people and animals. From the literature review, it is evident that safety is of critical importance. Organizations involved in business focus on ensuring the materials reach their destination without incidences. Researchers have found there is a collaboration between the organizations involved in the processes and the government. The interaction has increased compliance, a matter that has reduced incidences. However, in case accidents happen, companies have comprehensive strategies meant to protect the public and reduce the impact of the materials’ exposure.

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