

The Robust Framework for Inventory Handling in Warehouses: Equipment Operations

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Abstract— In warehouse management, the equipment operators' ability to perform safe and efficient operations is vital to handle inventory in excellent performance. This paper includes a review of common equipment utilized to move inventory received from suppliers or issued to customers, and general operational activities in warehouses. The study findings revolve around the common unsafe equipment operating practices, which results in damaging the inventory, and reveals its deficiencies. Furthermore, the paper's contribution showcases the optimal framework to ensure smooth and safe inventory handling operations via regular equipment inspection, routine preventive maintenance, daily checklist and checkups along with safety and operational excellence mindset of operators in equipment driving.

Keywords— Warehouses Network, Inventory Handling, Safety Framework, Preventive Maintenance, Technical Inspection.

1. Introduction

Warehouses are an integral part of every healthy and resilient supply chain. Whenever a strong network of warehouses is close to the organization's customers, the supply chain establishes sustainability. Through increasing the amount and locations of warehouses, businesses can have flexibility and benefits from shorter time to market, as products will be stored closer to customers and consumers [1]. The right management of warehouses can benefit businesses tremendously in responding to customers' inventory demand and support the implementation of cost-saving initiatives within the facilities such as space optimization.

Warehouse inventory management is the process by which stock stored in a warehouse or other storage facility is received, tracked, audited, and managed for order fulfillment [2]. Typically, the materials stored vary in sizes and shapes and require warehouses to build appropriate storage structures to hold all of the inventory such as but not limited to racks, open yards, drawers, and shelves. The inventory moves continuously either through outflow by issuing materials to customers or inflow by receiving them from suppliers and stock replenishment.

Whenever a material request comes in, warehouse employees should be able to pick, pack, and ship the material to the customer via the logistics carrier on time. Materials need to be handled carefully at every step of the supply chain to make sure they arrive at their destinations intact [3]. To ensure efficient and effective handling of inventory, specialized equipment such as forklifts and others needs to be utilized inside the warehouse.

Equipment are the stallion workhorses to move inventory. Without them, many of the storing and issuing jobs would not be managed. The warehouse's operation depends on them heavily to hoist and transport materials. Since operating a piece of equipment is a specialized job that requires training, certification, and authorization, only qualified operators are allowed to operate the equipment.

The main purpose of this paper is to showcase a robust framework to move the inventory in warehouses via equipment safely. The paper illustrates common

unsafe practices of equipment operators and also optimal operating practices and framework to overcome deficiencies.

2. Literature Review

The optimal framework of inventory handling is one of the crucial goals all warehouse management aims to achieve and realize. Inventory handling framework will aid supply chains in maintaining safe and effective operations and decrease the costs of equipment failures and inventory damages. Equipment operators and preventive maintenance crews can provide high quality execution of inventory handling operations to ensure protection of supply chain inventory along with safety of warehousing personnel..

3. Equipment Suitability for Inventory

The stored inventory can vary from small items in boxes usually stored on wooden pallets to large and heavy pipes on racks. Issuing materials to customers necessitates the appropriate utilization of equipment or tools to prevent damage to inventory.

The equipment are to be used to load and unload shipments. The most common amazing pieces of machinery used in warehouse operations are the following ones:

- Forklift 2.5 TON
- Forklift 8 TON
- Forklift 20 TON
- Lansing Forklift
- Counterbalance Forklift
- Stock Picker/Manlift
- Pipe Loader/Logger
- Crane

All of the above equipment does not need to be utilized in warehouses. Supply chain warehousing personnel may elect to add other equipment, depending on what is the appropriate handling method for the type of inventory stored and maintained by the organization. By knowing more about materials handling equipment, you can better outfit your facility with the right equipment and systems for your company needs [4]. The space and layout of the facility is another crucial factor in selection to ensure the equipment can safely navigate and reach materials.

As a result, the accurate selection of equipment produces significant benefits mainly in operational efficiency by reducing stoppages, minimizing manual labor, and improving the circulation flow of materials. Manual movement of materials or products across the facility floor could result in product damage if the materials are not handled carefully [5]. Consequently, the safety of employees is improved by eliminating manual labor and preventing materials from falling on personnel.

4. Common Unsafe Operating Practices

Driving too fast, making sharp fast turns, and breaking too hard while holding a load are considered unsafe driving practices that can damage the inventory. Even making fast and sharp turns without a load is unsafe as, for example, it would lead to the unloaded forks tipping the forklift over. The equipment operators can also lose control of the equipment and potentially cause injuries and accidents to property and staff. For instance, forklifts can become very unstable when driven in a fast fashion as they have a movable center of gravity. The forklift center of gravity is a fundamental concept that plays a pivotal role in the stability and safe operation of forklifts [6]. Fast starts, especially in reverse, can shift the load or cause it to fall off the forks. Modern forklifts are equipped with Stability Active Systems (SAS), which helps to reduce and prevent accidents, but as a common safety rule, never turn while driving across, up, or down a ramp or incline. The reason for that is that forklifts are built narrow and their center of gravity can shift quickly outside the stability triangle, causing the equipment to tip over.

Deficiencies in handling inventory loads are major unsafe behavior reported and observed in warehouses. Unfortunately, accidents can occur for those involved in the transit or individuals nearby if people do not take the required steps to prevent them. Having a well-balanced load is crucial [7]. Operators would load the materials by not spreading the forks, clamps, or hocks as far apart as possible and not situate the load's center of gravity in the middle. Also, placing loose loads of boxes or cartons above the level of the backrest can cause the materials to fall off on the equipment and operator. For example, all pallet loads must be secured

before the forklifts attempt to lift them. Loads should be distributed properly to avoid falling off and causing injuries and damages.

Operating in the same manner regardless of external factors such as route conditions, weather, and restricted clearances is another unsafe practice causing accidents. For example, driving equipment in slick spots such as oil, water, potholes or soft sand can cause the operator to lose control of the equipment and loosen the materials to fall off. Additionally, operating the equipment without consideration of height and width clearances needed for the load or equipment can result in damages. The height clearances are especially important as in the warehouse layout, the electrical cable might be present. Lastly, not keeping a safe distance from the edge when operating on docks and platforms causes the equipment's tail to swing when making a turn near the edge.

5. Operating Equipment Safely

5.1. Equipment Operating Procedures

Safe equipment operating procedures are accomplished when rules are applied and followed properly. Operating rules are made to keep the equipment operator safe from injury. Also, safe operations will prevent damage to inventory, property, and utilized equipment. Equipment operators should adhere to the following procedures:

- The Operator should operate only the equipment for which he or she has been trained and certified in.
- Know your equipment capabilities before you drive it and never operate equipment beyond its rated capacity.
- A daily pre-operational inspection, which includes checking service stickers, battery, fuel, water, oil, steering, hydraulics, safety devices, horn, lights, brakes, seat belts, and backup alarms.
- Do not use the equipment if there are any defects and instead report the situation to management promptly.
- Always wear your seatbelt and keep all parts of your body inside the equipment cage or compartment.
- Drive safely at all times and follow safe driving practices.
- Do not enter the storage rack when it is already occupied by other equipment or has personnel inside.

- Position the load evenly and look out for its center of gravity.
- Never keep passengers or involved in equipment horseplay.
- Never carry loose or poorly stacked loads.
- Never see equipment to lift people.
- Exercise extreme caution on the ramps or grades.
- As you drive at intersections, slow down, look for traffic, and sound your horn frequently.
- Adhere to all warning stickers on equipment.
- Follow all traffic signs when operating equipment.

5.2. Equipment Technical Inspection

The technical inspection of equipment is to be completed on an annual basis by certified third-party inspectors to diagnose the status quo of equipment and determine the possibility of usage going forward. Such inspection includes mainly assessment of engineering structures, compliance with safety requirements, quality control of mechanical systems, locating defects, and identifying remaining years of services for the equipment [8].

After successfully passing the technical inspection, the equipment receives a sticker for one year validating its condition to continue operation. These inspection stickers are necessary to maintain safe operations, identify potential failures or defects early on, and retire equipment once they are worn out.

5.3. Preventive Maintenance (PM)

Preventive maintenance (PM) is the regular and routine maintenance of equipment and assets to keep them running and prevent any costly unplanned downtime from unexpected equipment failure [9]. Such services shall be in alignment with the manufacturers' guidelines and standards to ensure the detection of any potential issues in a proactive manner rather than reactive along with mitigating the risk of operational stoppages due to equipment failures. PM tries to ensure equipment related losses are minimised and more effort is made to reduce equipment-related losses or defects [10]. In Addition, preventive maintenance services add value by improving the lifespan of the equipment.

5.4. Daily Inspection Checklist

Whenever a warehouse utilizes equipment to handle inventory, it is essential to maintain and verify those pieces of machinery to be in good working condition to run operations smoothly. This is done through a checklist that is formulated based on the equipment type and to be used daily, which is also an industry standard. An equipment checklist for inspection is used to assess whether the equipment meets the safety and quality standards before being used [11].

5.5. Pre-start Checkup

Operators are responsible to keep the equipment in a safe condition by completing a regular safety and pre-start checkup at the start of every shift. A good equipment operator knows his or her machine. The operator must know the major parts of the equipment and how they are inspected. Such checkups can be completed in minutes and this small amount of time may save lives. They are very simple and easy to perform.

Beginning with tires and wheels. If the equipment is fitted with air-filled tires, make sure the air pressure is in alignment with the manufacturer's standards. Remove any embedded sharp objects such as broken glass and nails, from the treads. Make sure all the wheel nuts are in place and are tight. Moving on with checking the load chains, anchors, hocks, forks, or clamps depending on the equipment for cracks, corrosion, and broken links or pins. Ending with assessing the hydraulic rams, hoses, and connection fittings for any damage or leaks. Any found observations should be reported to warehousing management to be resolved immediately and take the right action to ensure the safety of personnel and facilities.

5.6. Operating Vigilantly

The equipment operators are responsible for their safety and of others and must always operate vigilantly as they are the first line of defense in materials handling operations. Accordingly, the following best practices are to be adhered to ensure effective and safe measures:

- Observing your surroundings for any obstacles or staff members is vital to avoid potentially hazardous situations.
- Speed should be continuously monitored and kept at low levels as the warehouse equipment are not racing cars and should always start and stop smoothly.
- Look over your shoulder when reversing and do not rely solely on mirrors as you must clear your blind spots.
- If a load blocks your view then either travel in reverse or reduce the load if possible.
- Never try to lift or carry loose or poorly stacked loads. Stack and bind load correctly to prevent accidents.
- It is very important as you lift and transport loads to watch for overhead obstructions such as pipes or cables.
- Stay inside equipment with hands and feet or under the overhead guard as it is designed to protect the operator.
- Only authorized personnel are allowed to operate the equipment.
- Do not use your cell phone while operating equipment
- Never lift people using the equipment.
- Never let anyone walk or stand below or on a raised load.

6. Conclusion

This paper illustrated the Correlation between resilient supply chain warehouses and utilized equipment for inventory movement. This paper revealed the optimal safety framework for inventory handling in warehouses via equipment. The paper findings identified the deficiencies and the most common unsafe operating practices that are observed in handling inventory. On the other hand, the study contribution showcased the best practices and industry standards in equipment operating procedures along with highlighting the benefits of preventive maintenance (PM), technical inspection, and daily equipment checklists and checkups. As warehousing networks around the world expand in operations and inventory levels rise to achieve supply chain resilience, more and more equipment with operators will be utilized and it is vital to enforce robust equipment operating safety measures.

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