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Warehousing and Warehouse Management

The act of storing goods in order to sell or distribute them in future is known as warehousing. The different processes which are related to maintaining and controlling the warehouse of a business are known as warehouse management. This chapter discusses in detail the theories and concepts related to warehouse management and the different types of warehouses.

Warehouse

A warehouse is a large building used for storing goods before they are sold, sent to the shops, exported or imported, or used. Put simply, it is a large place for storing things.

In the UK and some other English-speaking countries, warehouses may be large retail stores, as in: "We bought our dining table and chairs from a large furniture warehouse 10 miles out of town."

As a verb, it means to keep something in a warehouse, to store it, as in: "They only managed to sell 2,000 of the 10,000 units in January, leaving 8,000 units warehoused and unsold."

Manufacturers, wholesalers, exporters, importers, customs agencies, transport companies, and many other types of businesses have or use warehouses.

The physical and administrative functions related to keeping materials and a product in a warehouse is known as warehousing.

An automatic storage warehouse for small parts. Warehouses today are becoming increasingly automated – where robots do the work that humans used to.

Warehouses Common in Industrial Parks

They are generally very large plain buildings in the industrial parts of towns or cities, or out of town but close to major road, rail, air, or sea connections.

Warehouses usually have a loading dock, where goods are loaded onto and unloaded from trucks. In some cases the goods are loaded directly onto train wagons, airplanes, or ships.

Goods stored in warehouses include raw materials, spare parts, packing materials, components, finished products, and goods associated with manufacturing, production and agriculture.

Large warehouses may have cranes for moving goods – most of them have forklift trucks.

Benefits of Warehousing

1. Safety and Preservation: Manufacturers, importers, wholesalers, exporters, traders and stockiest use warehouses to store their goods (raw materials and finished items) before distribution and sale. Besides, serving the storage purpose, warehousing facilitates preservation facility against water, fire, theft and climatic changes. Due to technological advancements, safety measures and computerization, warehouses minimize spoilage, errors, accidents, omissions, breakage, deterioration in quality etc.

2. Trouble Free Handling: Today warehouses are usually large plain buildings in industrial or institutional areas of cities and towns equipped with loading docks to load and unload trucks, from railways, seaports or airports. They also have automatic forklifts and cranes for moving goods from one place to another within the warehouse area. Some warehouses are completely automated with no workers working inside resulting in minimum wastage and easy handling during loading and unloading goods.

3. Ensuring Continuous Supply: Certain commodities like agricultural products are produced during a certain period of year but consumed or required throughout the year. Warehouses ensure adequate supply of such seasonal products throughout the year without any break.

4. Lifeline for Small Traders: Due to rising costs of land and financial limitations, small traders cannot afford to have their private warehouses. Public or government warehouses facilitate them to store goods at affordable rates. In absence of warehouses, it will be difficult for small traders to survive in cut-throat competition because 'stock out' situation if persists for long, can disrupt the image and goodwill of the traders especially the small traders who have no/limited marketing budget to spend.

5. Assisting in Continuous Production: Warehouses facilitate the manufacturers to produce goods throughout the year without much attention of raw material shortage. The manufacturers who usually produce in bulk require raw materials in large quantity. Warehouses assist them to provide agricultural (seasonal) and industrial goods all over the year.

6. Location Advantage: Most of the warehouses are located at a convenient place near railways, highways, seaports and airports that facilitate smooth movements of goods. Further, convenient location reduces the distribution cost to great extent.

7. Employment Generation: Warehouses are usually large plain buildings in industrial areas of cities and towns covering huge storage area. Warehouses located in or near industrial areas are so big that can store goods of large number of businessmen at a time. Further, besides storage, warehouses perform several functions like procurement, sorting, dividing, marketing, preparing for shipment, handling, inventory control, display, order processing,

financing, transportation, grading and branding and so on resulting in employment generation in various sections and at various levels. It is the source of bread and butter for several laborers, workers, employees and officers.

8. Financing: When businessmen store goods in the warehouses upon certain formalities, they get 'deposit receipt', which acts as a proof about the deposit of the goods. Warehouses also issue a document in the name of owner against storage of goods, which is known as warehouse-keeper's warrant. This document can be transferred by simple endorsement and delivery. Businessmen on account of these documents (warrants) may get financial aids/loans from banks, private tenders on financial companies. In some cases, warehouses also provide finance to the businessmen on keeping goods as collateral security.

9. Risk Reduction: Warehouse owners/authorities make certain that the goods stored in their warehouses are well protected, preserved and monitored. In order to keep proper information about good details, to save goods from theft and pilferage, warehouses employ employees and security staff.

   For perishable items, they provide cold storage facility, to protect warehouse from fire, fire-fighting equipments are used. On requirement, goods stored may be insured against unforeseen mishaps like loss due to fire, theft and natural disasters.

10. Assisting in Selling: Most of the warehouses, as per requirements from depositors' side, provide assistance towards inspection of goods, sorting, branding, packaging, financing and labeling that is essential towards sale of goods. In certain cases, transport arrangements may be availed to depositors for their bulk deposits.

Warehouse Logistics

Warehouse logistics encompasses all the varied, complex factors – organization, movements, and management – involved in warehousing. This includes the flow (shipping and receiving) of physical inventory, as well as that of more abstract goods, including information and time.

Warehouse logistics may also extend to anything from warehouse pest control, to damaged goods handling, to safety policies, to human resources management, to customer returns. In other words, warehouse logistics involves all the policies, procedures, and organizational tools necessary to keep your warehouse operations running smoothly.

Common warehouse logistics challenges revolve around organization: Simply put, how can you achieve detailed control over something as large as a warehouse.

And yet, you must. You must be able to pinpoint the exact location of a specific item of inventory, the pallet that carried a purportedly expired food item, or the truck that shipped an item damaged during shipment. These controls are paramount to smooth operations and healthy revenues, and yet, without expert tools, they are nearly impossible to achieve.

Warehouse challenges run even deeper than these immediate concerns, extending into inventory management, supply chain management, cost controls, human resources, risk management, and security, among other factors. So, how can you achieve enough flexibility to stay competitive, while

maintaining adequate offerings to please customers, while still exercising sufficient controls to protect your revenues? These are the questions facing warehouses today.

It's indisputable: warehouse managers have a lot on their plates. Luckily, you also have increasingly helpful, incredibly powerful tools to help you meet the needs of your warehouse, the requirements of your employees, and the expectations of your customers.

Advanced warehouse management systems (WMS) give you real-time insight into your warehouse, and equip you – and all your employees – with the necessary tools to effectively, efficiently and profitably manage your warehouse.

Indeed, a WMS is not only a sure way to improve warehouse logistics but is also a must in today's warehousing. More than an inventory control system, warehouse management systems take control of all warehouse logistics, from inventory control and management, to order fulfillment. Many WMS today incorporate mobile tools, so your warehouse managers and employees can consult the system on the go, via smartphone.

Comprehensive WMS also combine traditional management tools with warehouse control systems (WCS) to create a whole-warehouse synergy to improve your overall logistics, from inventory receipt to shipping.

Benefits of Warehouse Logistics

The benefit of controlled warehouse logistics is simple – increased revenue.

When your warehouse operations run smoothly, inventory is properly accounted for, the right item is sent at the right time, stock is replenished when needed, fewer picking errors occur, and all the people, processes, and systems fall into place as they should, your warehouse operates more efficiently. There are fewer errors and fewer problems, and that means maximized revenue.

When you implement a solid WMS to control your warehouse logistics, you:

- Ensure accurate, real-time inventory counts: Know how much inventory you have – and its specific location within your warehouse.
- Decrease returns: An accurate look at your inventory means sending the right item, the first time.
- Auto-replenish stock: Don't wait until you're out (or nearly out) of stock to order more; let your WMS auto-replenish inventory when stock levels get low.
- Maximize warehouse space: Some WMS automate warehouse routines (ex. stock rotation and picking), which means you'll need less floor space for workers, which in turn means maximizing your warehouse space to store more inventory.

Other WMS benefits extend to better demand planning, improved visibility and transparency, stock traceability, fewer picking errors, optimized processes, efficient labor allocation, and improved customer services – factors that boil down to reduced operational expenses and more revenue.

Warehouse Considerations Influence Warehouse Logistics

Without a doubt, a capable WMS can transform your operations and optimize logistics. But a software tool, no matter how powerful, can only go so far as human error. In real-life settings, warehouse considerations heavily influence your logistics.

Your warehouse managers and, to a certain extent, all involved employees must be well trained in using your equipment and WMS. Your transportation, 3PL, and related contractors and suppliers must coordinate with your logistics efforts. Any changes to your warehousing – new racking, updated organization, etc. – must be accounted for in the system, or problems will quickly manifest.

Warehouse logistics are not static. They change with your physical needs, your inventory, your employees, and any other factors that they govern. In the end, while you can implement tools and procedures to help govern and control warehouse logistics, smooth operations hinge on watchfulness, proper training, and evolving policies.

Warehouse Management

Warehouse management is the act of organising and controlling everything within your warehouse – and making sure it all runs in the most optimal way possible.

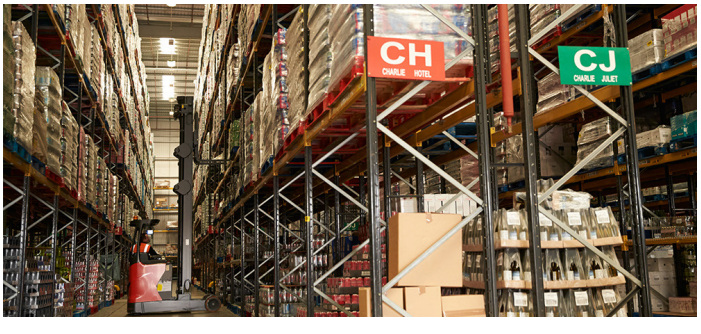
This includes:

- Arranging the warehouse and its inventory.
- Having and maintaining the appropriate equipment.
- Managing new stock coming into the facility.
- Picking, packing and shipping orders.
- Tracking and improving overall warehouse performance.

Most high growth retailers would use automation tools (like some form of Warehouse Management System) to control this part of their supply chain.

However, there are many aspects that can and need to be considered from a manual standpoint.

Arranging your Warehouse



Probably the most important first step in optimising your warehouse operations is making sure you have everything in there arranged in the most efficient way.

Think to consider:

1. General warehouse layout: Planning the layout of your warehouse is centred on balancing two things:

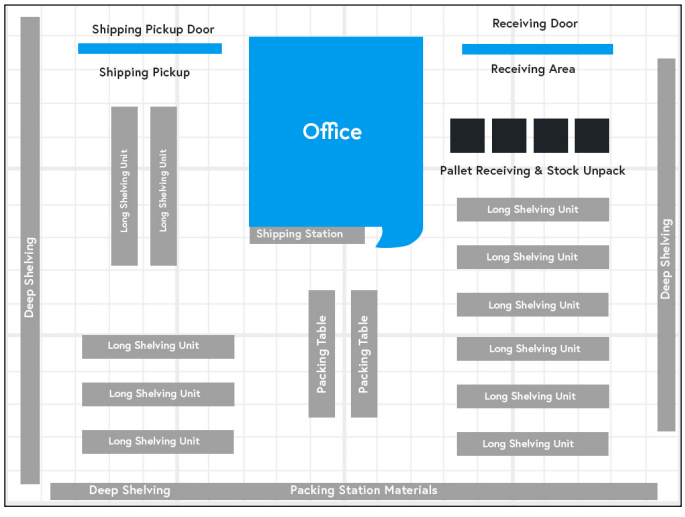
- Providing enough storage space for your inventory,
- While still having enough working space for staff to move around and complete their tasks.

And this generally requires (although it depends on individual business requirements) having a space designed to house the following areas:

- Receiving new stock area,
- Unpacking and booking in new stock area,
- A warehouse office,
- Main storage area,
- Excess, obsolete or dead stock storing area,
- Packing area,
- Shipping station.

This can be tricky – especially when dealing with a limited space. So it's best to sketch out your warehouse layout to scale before setting it up or changing what you already have.

Using a grid system makes planning this a lot easier:



Space and manoeuvrability is a key thing to remember.

Pickers need to be able to walk up and down aisles without getting in each other's way. And should also have enough room to actually pick items.

2. Labelling areas of your warehouse: Effective warehouse management can't be done without set location names for stock that have been clearly labelled.

Your team should be able to look at your warehouse system and see exactly where any product is located.

Practicality is king here. Sticking with simple alphanumeric combinations makes it easier to understand and decipher for pickers trying to reach that site location.

For example, you can start by simply including labels for specific rows, shelves and then exact bin locations:

Row	Shelf	Bin
A	A	1
A	A	2
A	B	1
B	A	1
B	A	2
B	B	1

So you always know, for example, that your entire blue t-shirts sized medium will be in *Row A – Shelf B – Bin 1*. And the pattern can be continued like this.

Bigger warehouses with more rows may need to add a little more detail:

Row	Shelf	Bin
A1	A	1
A1	B	2
A2	A	1
A2	B	2
B1	A	1
B1	B	2

And then even larger warehouses may even need to be split up into different areas for each row and the facility as a whole:

Warehouse Area	Row	Row Area	Shelf	Bin
Area 1	A1	RA1	A	1
Area 1	A2	RA2	B	2
Area 1	B1	RA3	C	3
Area 2	A1	RA1	A	1
Area 2	A2	RA2	B	2
Area 2	B1	RA3	C	3

How detailed you go with labelling depends totally on the size of your facility or site, complexity of your warehouse operations and a range of other factors.

But in short, the bigger your facility, the more in-depth you'll need to go with your location labelling to achieve optimal warehouse management.

3. How to arrange inventory in the warehouse: So at this point we have a warehouse that's laid out and labelled in the most optimal way for your business. But this now raises the question:

How do you determine the exact location each product should be stored?

Answer: keep better selling products closer to the packing desk.

Research we conducted on over 20 Veeqo retailers found that 60% of a company's sales tend to come from just 20% of their products. Meaning you can severely reduce picker walking time by:

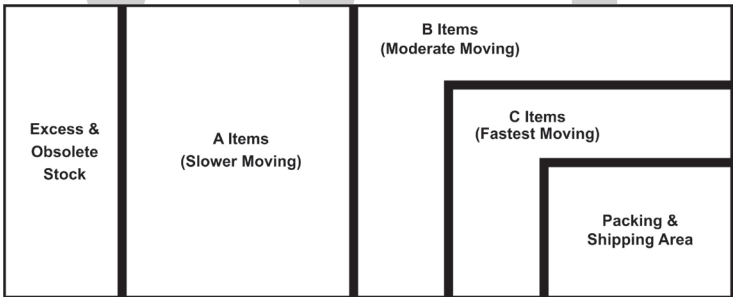
1. Identifying that 20% of products from past sales data in your business;
2. And then storing these as close to the packing desk as possible.

Tools like ABC Analysis tend to be used more in inventory management. But this can provide some handy information when it comes to this part of warehouse management too.

Divide all on-hand inventory into three groups – A, B and C:

- A Items: Are of high value with low sales frequency.
- B Items: Are of moderate value with moderate sales frequency.
- C Items: Are of low value with high sales frequency.

You can then decide that 'C items' will be placed closest to the packing desk, while 'A items' will be farthest away. Like this:



Some small and lightweight items may even be sold frequently enough to warrant being stored on shelves above the packing desks themselves.

This means packers can quickly add these into relevant orders and pickers can focus on bigger items.

Finally, you can take this concept another layer deep by also identifying which products are most commonly sold together.

So faster selling products are stored closer to the packing desk *and* products commonly purchased together are stored close or next to each other. Meaning you're doubling down on reducing walking time for each picker.

4. Don't be afraid to rearrange: A small final point in this warehouse management section is this:

Don't be afraid to rearrange your warehouse.

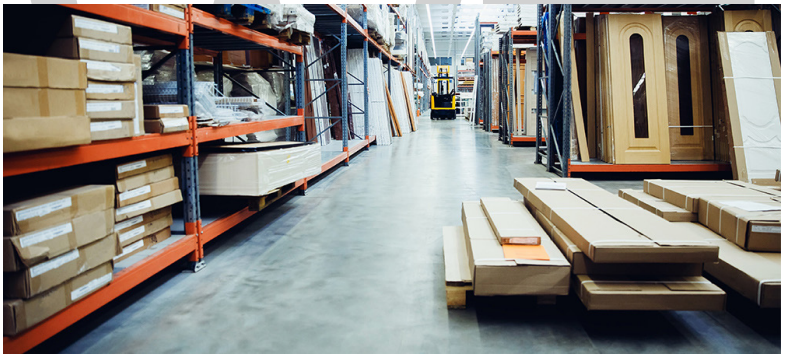
Yes – it can take time and resources to implement and may seem like more hassle than it's worth. But an optimally arranged warehouse can save bags of time overall and severely reduce costs for entirety of your supply chain management.

While inefficiencies can seriously hamper growth. So regularly evaluate and – if necessary – rearrange or upgrade.

For Example: It may be that your best selling products in summer become your worst selling come winter, and vice versa. Or you sell more of specific products on key retail dates through the year. Or you've switched some products to prestige pricing that might not sell quite as frequently.

So it makes sense to rearrange these products in line with this when the time comes – moving some closer to the packing desks and others farther away.

Receiving and Managing New Stock



Stock doesn't just appear out of nowhere. And so a critical part of warehouse management is being able to receive, unpack, put away and book in new inventory as efficiently as possible.

The faster this happens, the sooner that stock becomes available for sale.

And what's more, any errors or inefficiencies in this process will then cascade through the remainder of the entire supply chain.

Things to Consider

- Have appropriate space: There needs to be enough space in your receiving area to both temporarily house newly delivered stock without risk of damage *and* for your team to perform the necessary tasks with it.
- Have assigned workers: New stock needs to be dealt with as soon as possible – not left to build up. Make sure it's clearly communicated whose job it is to do this.
- Record everything: It's a good idea to record relevant details to fall back on if there are any problems – e.g. exact timestamps of when new stock arrives and is put away.

- Inspect carefully: Dedicate some time and resources to ensuring all new deliveries are correct in number and free of damage. This is a great opportunity to identify any vendor, inbound shipping or packaging problems.
- Put away: Add any necessary labeling or barcodes before physically putting the stock away to be stored in its relevant warehouse place.
- Update inventory: Make sure all the stock levels are correctly updated on each sales channel or inventory management system – meaning it's live and ready for purchase.

Receiving via Digital Mobile Scanner

It's worth noting that a mobile scanner device can make this whole booking in process much quicker and more accurate.

Rather than needing to sit at a computer and individually find and update each product, you'd simply:

- Scan a product or purchase order.
- Update inventory levels on the mobile screen – making the inventory available for sale.
- And put it away in the warehouse.

Making it a much easier and quicker process.

Warehouse Management Fulfilment Strategies

Being able to fulfill orders quickly and accurately is an absolute staple of good warehouse management.

After all, it's pretty much the entire reason for the warehouse existing in the first place.

Here's what you need to think about when it comes to picking, packing, shipping and your distribution strategy in general:

1. Choosing an Optimal Picking System

Picking may seem like a simple concept at first. And it is – when you only have a few orders to deal with.

But this becomes a much different story once you're dealing with hundreds (or even thousands) of multiple item orders each day.

In fact, research we recently conducted on 20 Veeqo retailers found that 70% of labour time when processing an order is spent on just picking the products. And 60% of a picker's time is taken up by simply walking around the warehouse.

So getting a solid picking system in place can have a major impact on overall distribution productivity.

These are the four main picking systems or methods used by medium to large retailers:

Single Order

This is the most basic picking method – typically only used by those just starting out. Quite simply, a picker will pick one order at a time in its entirety before moving on to the next.

- Best for: Retailers just starting out who aren't yet big enough to gain the benefits of more complex picking methods.
- Avoid if: You ship more than 20 customer orders a day (or plan to in the near future).

Batch Picking

The picker is assigned a batch consisting of a number of orders, picks them all in one go and then returns to a packing desk. The picker will then get assigned a new batch to pick.

The number of orders allocated to each batch is generally between 10 and 30. But this really depends on the physical size of your products and average order size.

- Best for: High number of orders with single or low number of products per order.
- Avoid if: You have a high number of products per order (or are aiming for this in the near future).

Zone Picking

This sees each picker assigned their own area (or zone) of the warehouse with them only picking products stored in that specific zone. An order is passed through all areas to have any required items added to it by pickers in that zone before being returned to a packing desk.

Great for preventing multiple pickers getting in each other's way, but it can also create a slight delay in shipping as each order needs to be passed around the warehouse.

- Best for: Retailers typically shipping a high volume of multiple item orders.
- Avoid if: You typically ship single or low item orders or have very few pickers.

Wave Picking

Similar to zone, but all zones pick at the same time. The various items are picked in the according zone and are then given to a packer who will consolidate all the separate picks for each order.

This is faster than zone, but labour costs increase due to the packer needing to spend more time combining orders at the end before needing to be shipped.

- Best for: Retailers typically shipping a high volume of multiple item orders and still wanting to maintain a super-fast process.
- Avoid if: You typically ship single or low item orders, have very few pickers or cost is more important than speed of dispatch.

Here's a quick summary of all four methods:

Picking Method	Order volume	Items per order	Best for	Setup cost
Single order	Low	Med -High	Startups	L
Batch	Low -High	Low- Med	High volume o item orders	LL
Zone	High	Low- Med	High volume with a lot of products per order	LLLL
Wave	Med -High	Med -High	High volume with multiple items per order	LLLL

2. Optimising your Packing Process

There's more to packing than just throwing items in a box as quickly as possible.

It's an opportunity to make completely sure that you're sending the right products to the right customers and in the most efficient way.

Here's what you need to consider:

Box Size

More and more shipping companies are incorporating package dimensions into their pricing – rather than it being based solely on weight.

Meaning box sizes could be having a direct impact on costs.

However, Having 50 different box size options is a great way to overwhelm packers and severely slow down warehouse operations. So there's a balance that needs to be struck here.

Of course, it depends on your individual business needs.

If you know every order is the same physical size then having one box size makes sense – and it's a lot easier for the packer.

But a typical retailer will usually do best with around 3-5 size options. This keeps things manageable for packers while still allowing room to minimise courier costs.

Packaging Material

Another element to the packing process is choosing the most appropriate packaging material.

This is all about striking a balance between:

- Keeping the goods protected during transit.

- Minimising the overall weight of the package (and therefore courier costs).
- Keeping the cost of the packaging material itself down.

Obviously, shipping a Fabergé egg is going to warrant a better (and more expensive) packaging material than if shipping a book.

So it's worth analysing your product catalogue (and track record of delivering damaged items) to determine the range of packaging materials you need to have available.

Here are some of the most common ones:

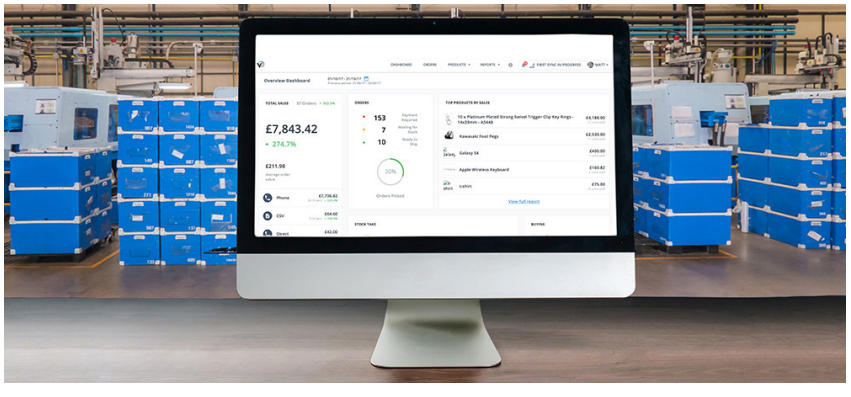
Packaging	Description	Protection rating
Bubble wrap	Two layers wrapped around products using sellotape to hold	75%
Packaging peanuts	Biodegradable or recycled foam peanuts.	90%
Shredded paper	Cheap and lightweight, but limited protection.	50%
Crunched paper	From paper dispenser and crunched by packer, limited protection.	50%
Shredded wool	Loose fill wool which is lightweight, but limited shock protection	60%
Air pillow	Plastic bags filled with air, very lightweight and good protection but require work to inflate	90%

3. Shipping your Orders

The next few steps in your warehouse management process are pretty straightforward:

- Weigh the package.
- Print out relevant shipping label (and invoice, if not already done so).
- Mark the order as 'Shipped' on the relevant sales channel or Order Management System.
- Send out 'shipping confirmation' and 'tracking' emails to the customer (a quality Order Management System will do this for you automatically).

Measuring Warehouse Performance



Tracking performance and working to improve it is essential when it comes to all parts of supply chain management.

And it's no different when it comes to warehouse management.

In general, this is all about two things:

1. Accuracy of fulfilling customer orders (without damage).
2. Speed of fulfilling customer orders (without damage).

With this in mind, here are the main KPIs you want to be tracking to specifically measure the success of your warehouse management process:

1. Receiving efficiency: This is quite simply how long it takes for your team to complete the receiving and putting away of a newly delivered purchase order.

It's a good idea to record exact timestamps for:

- New stock being delivered.
- When this stock is ready for putting away.
- Then again once the stock has actually been put away.

You can then calculate the difference in time between each point and work out an average for the month – allowing you to see how performance is trending in this area of your warehouse operations.

2. Rate of return: An order being returned isn't always down to a problem in the warehouse – a customer may have just had buyer's remorse.

So the key to getting best use out of this is to segment by reason for return. This way, the warehouse or operations manager can start looking at exact reasons why this KPI may be high and put into place strategies to resolve.

Determine several different return reasons and use the following equation to analyse each one:

$$\text{RATE OF RETURN} = \frac{\text{NO. OF UNITS RETURNED}}{\text{NO. OF UNITS SOLD}}$$

3. Picking accuracy: Tracking and segmenting rate of return properly lets you also analyse picking accuracy – a particularly key piece of data.

To calculate *picking accuracy*, use your total number of orders in a period along with data from the *rate of return* KPI in the following equation:

$$\text{PICKING ACCURACY} = \left(\frac{\text{TOTAL NO. OF ORDERS - INCORRECT ITEM RETURNES}}{\text{TOTAL NO. OF ORDERS}} \right) \times 100$$

4. Order lead time: Order lead time (or average order processing time) is quite simply how long it takes for a customer to receive an order.

You may want to divide this into various categories. For example, international orders, Amazon Prime orders or orders for special or larger products.

But generally, the lower you can get order lead time, the happier your customers are going to be – so long as it arrives in perfect condition.

Warehouse Management Systems (WMS)

A Warehouse Management System (WMS) is a software application specializing in supporting the day to day operations within a warehouse. The application does this by allowing the users to have a centralized system where different warehouse management tasks are managed through an interface on a handheld device or a tablet working in the warehouse or a desktop in the office. This makes running a warehouse both efficient and easy, and also ensures that minimal if any losses occur in the different warehouse processes. The real gain is in customer service. Imagine knowing exactly where every product is, knowing when to re-order, and how much to re-order or produce. These things seem like a business goal, but for a customer it means they can get the product faster, without backorders or errors, so they are more likely to return.

Working of Warehouse Management System (WMS)

A warehouse management system is used to control and track the transfer and storage of materials in a warehouse. The system involves a number of processes that are important when shipping, receiving, or even putting away materials and integrates with other systems in the supply chain to ensure data transparency throughout your enterprise.

Receiving Goods

The WMS provides a simple process that is to be followed when handling a shipment that has arrived at the warehouse. The process can be customized to suit different users' requirements but its core function is to ensure that all shipments are handled properly to minimize on losses and also save on time.

Tracking Inventory

A WMS enables warehouse owners to keep a tab of all the stock in the warehouse. This is important because it ensures that the warehouse management team is able to know when there is enough stock in the warehouse and know when to order for more stock to prevent shortages. This saves on space as overstocking is prevented and also ensures that resources are well distributed to ensure a smooth warehouse management.

Slotting for Efficiency

A WMS enables users to model an efficient way of storing different products in a warehouse depending on different factors like demand and weight. This ensures that the warehouse is arranged in such a way that products that move faster or are heavier are stored close to the door for faster processing of orders, and products that are used together are stored in close proximity. This makes running the warehouse easy and efficient.

Labor Visibility

The WMS system eliminates the need to get more labor to undertake some of the functions that are managed at a central point in WMS. Probably the biggest labor savings is eliminating full inventory

counts which can often happen monthly or even weekly. A WMS can allow you to do periodic cycle counts without interfering with day to day operations. Reducing on labor can obviously greatly cut back on expenditure simply because the system is not labor intensive.

Document Preparation

A WMS automates most of the different processes, eliminating the need for paper documents that are bulky, and eat up quite a huge chunk of money when it comes to purchasing them and storing them appropriately. By giving visibility to the system to everyone simultaneously, everyone has the data needed to do their job at their fingertips.

Picking and Shipping

A proper WMS ensures that the right product is picked based on your business rules (LIFO or FIFO). A good WMS will make sure that the right orders are shipped to the right people at the right time. With this accuracy, the mistakes that can arise when transporting goods are avoided and ends up as a more efficient and less costly transport system.

Customer Service

A WMS improves the overall customer service by ensuring that orders are received and processed on time, and the right products are delivered to all customers when and where they need them. The quality of products is maintained enabling users to retain their customers and attract new ones.

Tracking and Visibility

For industries that require advanced tracking capabilities, a WMS will allow you to track lot information, expiry dates, UPC, and serial numbers. Each data point adds to the cost to maintain, but often comes with great returns when advanced visibility is required. Recalls and warranty issues are quickly resolved by solving the root problem through trace back instead of just a payout to the customer.

Reporting

The best Warehouse Management Systems will be in an easy to use database, like Microsoft SQL and include many reports out of the box. One hidden advantage to having systems is the ability to look at data in new and exciting ways. What percentage of your warehouse is utilized? Should you expand, or find a smaller space? How many transactions is each employee doing per hour? Can you reduce headcount? Can you negotiate better rates with your parcel service based on your cube and weight throughput? Is your pick path setup to be as efficient as possible for your pickers.

Warehouse Management System (WMS) and Supply Chain

In a fully integrated solution you will have your raw materials received into your Warehouse Management System, be consumed by your Material Requirement Planning system and the finished goods be deposited back into the WMS. The WMS will facilitate the tracking of the product

through moves and cycle counts while in the warehouse, then finally be picked and sent to either the shipping system or Transportation Management System to route your trucks. The entire time your Enterprise Resource Planning system will be tracking the values, orders, sales, and invoices with all of the systems.

Characteristics of Warehouse Management System (WMS)

There are different types of WMS ranging from simple uncomplicated systems to more complex ones that are more suited for large warehouses. When looking for a WMS system for your warehouse, there are different factors you need to consider before you can settle on one WMS. Some of the things to consider include:

Functions

Different WMS can perform different functions and are built for different industries. What functions does your business need to meet to satisfy the needs of your customers, any regulating bodies, and your shareholders? Look for a warehouse management system that is configurable and able to scale past where you are, but to where you plan to be in five years.

Warehouse Size

Larger warehouses require more detailed systems than smaller ones. This is because more activities and functions are carried out in a large warehouse and all such activities and functions require a more detailed system. The larger the warehouse, the higher the cost of travel between locations, and therefore the more important detailed tracking is.

Customer Needs

By identifying the loopholes in your current system, you will be in a position to determine the functions you require in a WMS, and select a WMS that will ensure that you are able to serve your customers better and increase their satisfaction with the services you provide. Are you an ecommerce site that needs auto-allocation so your available inventory is always accurate? Do you need to post tracking numbers to your customers? Do you need lot tracking to comply with FDA regulation.

Cost

The cost of installing a WMS system differs greatly depending on the complexity of the system and the system vendor. Choose a WMS system that will serve your warehouse better by fulfilling all the required functions, and also one that your business can afford. Choosing a system that is way too expensive for you will only put your business in trouble and end up compromising the quality and efficiency you so much want to improve. Choosing a basic WMS system on the other hand might not serve you sufficiently, especially, if you have many functions in your warehouse. You have to find the right balance between cost and functions when choosing the right WMS for your business. Don't get caught thinking what your business needs are today, think of where your business needs to be in 5 years and choose a product that can take you there and beyond.

Benefits of Warehousing Services

Production Support

Timely, consistent production support can dramatically reduce your production lead times. At Shape CUT, our managed warehouse facility has the warehousing space and transport logistics expertise to safely store your precision-cut steel components until you need them. And when you do, those vital components are delivered where and when you need them, the same day, or the next day.

Opportunity to Expand

If you're not restricted by the need to store all materials, components and finished products at your manufacturing facility, you're able to focus on your core business: producing your products. By outsourcing storage and distribution to a warehouse or distribution centre, your business is better able to use existing space for product development and process improvement.

Packing and Processing

Today's warehouses and distribution centres do a lot more than simply store your products. A good warehouse will provide picking, packing and shipping services as well as inventory management. At Shape CUT, our inventory and logistics management processes are what allows us to manage Queensland's largest in-house range of steel, aluminium and stainless steel stock.

Price Stabilisation

Warehousing ensures a regular supply of goods into the marketplace by being able to store goods when supply exceeds demand and then releasing them when demand exceeds just-in-time production. Maintaining consistent stock levels helps prices to stay stable, making it easier for businesses to forecast production, profit and loss.

Financing

Using a warehouse can help with your financing arrangements because the business owner can borrow money against the security of the materials or goods in the warehouse. Then there's the additional benefits offered by bonded warehouses – facilities that are licensed by the government to accept imported goods for storage until customs duty can be paid. Storing imported goods or materials to be exported in a bonded warehouse helps control costs by paying customs duty proportionally.

Spot Stocking

This benefit is particularly useful for manufacturers that produce seasonal products. Spot Stocking is also a warehousing technique favoured by the agricultural sector. Instead of using a warehouse facility year-round or shipping direct from the manufacturer, Spot Stocking uses a number of warehouses simultaneously in a range of locations, close to key markets to reduce transport time and immediately meet customer demands.

Minimise Business Risk

Goods kept in a warehouse are insured at the risk of the warehouse owner. Storing goods at an off-site warehouse minimises inventory loss from theft, fire, damage, etc and transfers this risk to the warehouse. It's their insurance claim and the warehouse insurance company who will be paying any compensation.

Better Operational Efficiency

Regardless if your warehouse is in-house or you are outsourcing warehouse management, it should result in better efficiency. When you have enough space and its being managed the right way, this can reduce costs and make processes run faster and smoother.

Inventory and Stock Management

A good warehousing service provider has advanced technology and tools to give you increased visibility into your product stock. Therefore, it lets you manage and track all the shipping processes and forecast the next steps according to the data analysis. With accurate inventory insights, you can see what operations require optimization or elimination, and where you have strategy gaps.

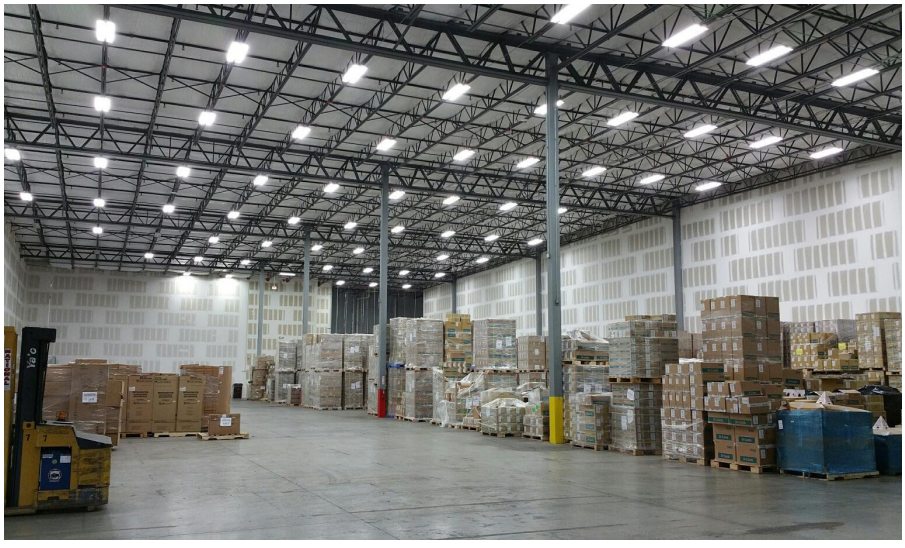
Customer Satisfaction

In the retail business, the customer's experience is the ultimate assessment of a company's success. Customer service is often a weak link in the business strategy. Perhaps effective warehouse management can fix it in your case? It may seem like there's barely any connection between purchasers and storage facilities. However, properly managed inventory and visibility into the stock can greatly affect the speed of order fulfillment and delivery. All of this results in fast shipping and increases your customer satisfaction within your company's services.

Although warehousing and storage are often underestimated, they are major contributors to your businesses performance. Practicing an efficient warehouse and inventory management strategy can take your customer service and productivity to another level.

Importance of Warehousing for Small Scale Businesses

First, it provides a central location for your products. Having a place to receive orders, store goods, and distribute products make the process systematic. With each arrival of shipment, responsibility goes to the warehouse personnel, and they're going to be in charge with identifying, sorting, and dispatching the products to their storage locations, looking over security measures and environmental hygiene. Then orders come and go, and warehouse personnel keep up with the records before dispatching. Warehouses ensure that there is a place to store goods when there is not quite enough demand for the supply. Instead of leaving the surplus products somewhere, having a warehouse ensures that the there is a good place for storage somewhere to keep goods until they are needed or wanted again without having to haul everything by your lonesome self.



Second, it adds value to your operation. The good thing about warehousing is that you are more in control of your shipping and handling. Because warehousing increases the value of goods by providing services that make products available at the most convenient way possible, it lowers the costs and increases the value of customer service. Warehousing operations such as consolidation and assembly add value to the logistics of the business.

Third, the efficiency, capacity, and location of warehouses provide economic benefits. Consolidating operations, for instance, cut costs for outbound delivery, which works well for both business owners and their customers. Instead of shipping individual products from a plethora of sources, central warehouses help package and ship orders together as a complete order, effectively eliminating expensive shipping costs. This is beneficial for making a turn in profit for businesses, especially new ones. Besides, most warehouses provide processing, packing, and blending, and grading facilities, meaning, small business owners can save more by not having to pay third parties in the order fulfillment process.

Fourth, warehousing is also an effective contingency plan to make sure that orders are sorted and done on time.

Warehouses provide custody of goods, and as an added benefit, products kept in warehouses are almost always insured. With systematic efficiency, good warehouses guarantee a 99.9% accuracy level of storage and inventory, allowing you to sit back and relax while other people to do the job for you.

Finally, warehousing allows you to focus on the more important part of your business: making it in the dog-eats-dog world without having to worry about too many things. Which is why warehouse and inventory management is important for small-and-medium sized businesses planning to make it in the great big world.

Of course, there are different types of warehouses for different types of businesses, but warehouses - whether private or public or bonded, are guaranteed to help lessen the gap between production and consumption, that is what you call a proper order fulfillment process.

Importance of Warehousing in a Logistics System

Warehousing is a requirement for most businesses that manufacture, import, export or transport goods. You might see it as an unnecessary expense, but it can actually save you money and boost your productivity. The customer journey doesn't end when an order is placed. A warehouse gives you better control over your inventory and ensures that customers will receive their products on time, which ultimately leads to higher profits.

Better Inventory Management

Approximately 8 percent of small businesses don't track their inventory. About 24 percent don't have inventory at all. This often leads to late shipments, delayed order processing and poor customer experience.

Warehouses provide a centralized location for your goods, making it easier to track and manage your inventory. By investing in a warehouse, you'll store, ship and distribute products more efficiently. If something is out of stock, you'll know it right away and provide customers with alternative options rather than leaving them waiting for days or weeks.

More Efficient Packing and Processing

Most warehouses provide the equipment and supplies you need to store, move, package and process orders from customers. Pallet racks, loading docks and packing materials are just a few to mention. This way, you'll have everything in one place, which will save you time and money.

A warehouse enables businesses to pack and grade their goods according to legal requirements and customer needs. The logistical cost is reduced, while flexibility is maximized. This type of facility can be an ideal distribution location, eliminating the need to arrange for pickup and hire employees to manage fulfillment.

Superior Customer Service

More than 63 percent of online customers expect to know the estimated or guaranteed delivery time. Approximately 88 percent would pay more for faster delivery. In fact, delivery speed is one of the first things buyers take into consideration when choosing a shipping carrier.

As a business owner, you want to keep your customer satisfied and engaged. If you fail to deliver their orders on time, your reputation will suffer. This can hurt your revenue and brand image.

Warehousing allows for timely delivery and optimized distribution, leading to increased labor productivity and greater customer satisfaction. It also helps reduce errors and damage in the order fulfillment process. Plus, it prevents your goods from getting lost or stolen during handling.

Ensure Price Stabilization

The demand for goods and services varies from month to month and year to year, depending on customers' income, government policies, employment rates, climatic conditions and other factors.

A warehouse allows you to store your products for a later date when the demand is high. This helps ensure price stabilization and reduces revenue losses.

Let's say your company manufactures and distributes sports equipment. If you offer ski accessories, you can store them in your warehouse rather than selling them for next to nothing when the cold season ends. This way, you'll maintain consistent stock levels and maximize your profits.

Improved Risk Management

Warehousing not only protects against price fluctuations but also provides safe storage of perishable products. Depending on your needs and type of business, you can lease a warehouse equipped with refrigerators, freezers and optimal temperature control.

Plants, artwork, candles, food and medications are just a few examples of goods that require cold storage. A warehouse that offers this service will store your goods at the right temperature, preventing spoilage and changes in color and texture. This also helps extend the product's shelf life and ensures customer satisfaction.

Additionally, the products stored in warehouses are typically insured. This means that you have higher chances to receive compensation from your insurance company in case of damage, fire or theft.

Types of Warehouses

Private Warehouse

The private warehouse is a storage facility that is mostly owned by big companies or single manufacturing units. It is also known as proprietary warehousing and can be operated as a separate division within a company.

The private warehousing can be done on on-site and off-site basis and serves as fixed corporate investment in land, building and equipment.

On-site warehouse: The on-site warehouse can either be at some centralized location or can be separately situated at different manufacturing facilities.

Off-site warehouse: The off-site warehouses are the storage facilities that are located closely to the marketing areas and are used for storing on-site inventory. These warehouses also serve as distribution center for finished goods.

Public Warehouse

A public warehouse is a business that provides short or long-term storage to companies on a month-to-month basis. Public warehouse fees can be a combination of storage fees and inbound and outbound transaction fees. A public warehouse can charge per pallet or charge for each square foot that is used by a company.

The public warehouse is not only a facility where a company can store their products, but the public warehouse offers inventory management, physical inventory counts and shipping functionality.

The public warehouse charges their clients for a certain rate for the goods stored, the volume of the warehouse used and the services the client wishes to use.

The company using the public warehouse does not have to employ warehouse staff, does not require any inventory software or warehouse equipment. The owner of the public warehouse is responsible for the costs and passes this on to their clients based on the rate they are charged.

Although most companies see public warehousing as a short-term solution it can often turn into a long-term relationship as companies been accustomed to convenience of the public warehouse services. Companies that own and operate public warehouses, invest significantly in modern facilities to remain competitive. They offer clients increasing levels of flexibility in order to retain and attract additional clients.

Public warehouses offer companies a range of labor solutions including picking, packing, inventory control software and dedicated workforce.

Public warehouses will also allow clients to bring in their own ERP or warehouse software so that the public warehouse becomes a satellite location with real-time data.

PW Offers

Public warehouse fees can be a combination of storage fees and inbound and outbound transaction fees. A public warehouse can charge per pallet or charge for each square foot that is used by a company.

Public Warehouses Offer more than Just Storage

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Criteria for Choosing a Public Warehouse

Because of the increasing competition between the public warehouse operators, potential clients should review the capabilities of each potential warehouse to identify which would be the best fit. Each client will have a number of factors that need to be considered when selecting a public warehouse. Companies have a variety of reasons why they require an outside warehouse, as well as their short-term and long-term needs and the price they are willing to pay for the service. However, the majority of the following criteria is likely to be used by all companies comparing public warehouse sites.

- Geography
- Technology
- Expansion
- Company Network
- Flexibility

Geography

The location of the public warehouse can be important to some clients, and less to others. If a large volume of items is to be moved between the company warehouses and the public warehouse, a

location closer to the company site may be more advantageous. However, some clients may require a public warehouse to be closer to their customers if items are to be moved there from a number of company sites.

Technology

Although most public warehouses offer modern facilities and technology, the level of technology may vary, for example, one public warehouse may offer a warehouse management system that is not compatible with common ERP systems. This can be less attractive than a warehouse that allows clients a range of warehouse solutions or for clients to use their own systems.

Expansion

Depending on a company's needs, the amount of space required at a public warehouse is likely to change during the period that space is required. Although space requirements are often unknown at the beginning of a contract with a public warehouse, the agreement should include an expansion clause. This will guarantee that the public warehouse operator will accommodate any future space requirements a company may need.

Company Network

When a company negotiates for space in a public warehouse, future requirements for other warehousing needs would probably not be known. However, a public warehouse that is part of a warehouse network may be able to offer national or global supply chain management services that smaller public warehouse operators cannot.

Flexibility

The flexibility of the public warehouse operator is an important consideration. Clients can need warehouse functionality at short notice and warehouse operators that can guarantee rapid access to the facility, with trained staff and suitable technology are at an advantage.

An optimized supply chain is one that delivers orders to its customer when that customer wants them - and does that by spending as little money as possible. If you can't afford your own warehouse, a public warehouse may be one solution.

Types of Public Warehouses

Generally, public warehouses are divided in three types as general merchandise warehouse, special commodity warehouse and cold-storage warehouse.

General Merchandise Warehouse

The warehouse where goods of imperishable nature such as raw materials, semi-finished, finished goods and other business commodities are kept is called general merchandise warehouse. Producers, wholesalers, and retailers keep their goods in such warehouses paying certain rent. In this warehouse, goods are kept safe from weather change. Such warehouses do not need arrangement of special temperature, humidity or any daily operation.

Special Commodity Warehouses

This type of warehouse is used to store the goods, especially agro-products and other special nature commodities. Special arrangement of warehouse is made for different nature goods. For example - separate arrangements are made to store agro-products like foodstuffs, wool, jute, cotton, tobacco, tea-coffee, and for fuels like petroleum, coal, chemicals and other special nature goods. Such warehouses are called special commodity warehouses.

Cold-storage Warehouse

The warehouse in which perishable goods are stored such as fish, meat, vegetables, fruits, eggs, cheese, butter and other dairy products, drinks, medicines etc. are known as cold-storage warehouse. Such goods are kept in cold-storage warehouse to protect them from heat, air, humidity, pollution etc. An arrangement of artificial chilling system is made in such warehouses. Nowadays, all types of perishable products can be kept safe in cold-storage warehouse and can be made available in market round the year. Such warehouse is also called refrigerated warehouse.

Public vs. Private Warehousing

Benefits of Public vs. Private Warehousing

Now that you know the difference between private and public warehousing, let's discuss the benefits of each storage facility option.

Benefits of Public Warehousing

Compared to private warehousing, public warehousing facilities are affordable, convenient, and flexible. There are a few reasons public warehousing is an attractive option. For starters, there's no capital investment required in public warehousing for things like building leasing and taxes, team on boarding and safety training. This means there's a low startup and usage cost.

Public warehouses require no long-term commitment, which makes it easy for businesses to change to a different warehouse if they don't like the one they're using. This also means there are many additional offerings to customers because of high competition in the sector. Some of these include:

- Specialty Storage – Temperature sensitive goods, hazardous materials, and perishable items all require special storage. While not every public warehouse can accommodate, many are certified to do so.
- Rail Siding – Clients utilizing rail or intermodal transport will require a public warehouse near a rail line. The best public warehouses will be situated very near the rail, while others will offer indoor rail line access right at the warehouse itself.
- Packing and Assembly Services – Great public warehouses will offer add-on services to help clients pack, assemble, and often ship their stored goods.

With convenient locations and multiplicity of clients, public warehouses often extend their high volume freight cost savings to their customers. This means public warehousing clients often benefit from freight cost savings. Public warehousing offers storage facilities of all sizes, which makes them perfect for small businesses or those looking to expand. Because of this, there's a great deal of flexibility for companies whose business ebbs and flows annually or seasonally.

Benefits of Private Warehousing

Private warehousing facilities typically offer abundant benefits to fewer customers, which public warehouses simply can't offer because of their size and scale. There are a few reasons private warehousing might be a more attractive option.

One of the biggest benefits of private warehousing is the high degree of control for clients. If you want to determine how best to utilize the space on your own, carefully track the internal flow of material or inventory, or keep a team working around the clock, a private warehouse offers unlimited control of the facilities. That unlimited control also means having to cover the cost of design, operation, and maintenance. Depending on the items being stored, the warehouse may also require special certifications and insurances. The high cost of private warehousing keeps it out of reach for most businesses.

Choose the Right Warehousing Facility

If you're not sure which warehousing facility is the right option for your business, reach out to the professionals at your third-party logistics provider. Amware works with business owners and shipping managers to find the right warehousing solution. As a public warehouse provider, Amware offers clients flexible space, specialty storage, indoor rail siding, and packing and assembly services.

Bonded Warehouse

Bonded Warehouse is a warehouse authorized by Customs authorities for storage of goods on which payment of duties is deferred until the goods are removed. When goods enter a bonded warehouse, both the importer and the warehouse proprietor incur financial and legal liability under a bond.

The concept of custom Bonded Warehousing has been promoted with a view to facilitate deferred payment of custom duty to encourage entrepreneurs and export oriented units to carry out their operations with least investment. The goods kept in the warehouse are safe and hence importer gets the time to arrange for the customs duty meanwhile. If the goods are not required immediately, they can keep in bonded warehouse for some time. If the importer doesn't have his own warehouse, he can transfer the title of goods to someone else while the goods still being in bonded warehouse and then buyer can pay the custom duties to get the goods. Importers can store their un-cleared cargo in bond facility, thereby avoiding heavy container demmurage or paying Customs Duty up front.

A bonded warehouse is a secured building or area that is used to keep imported goods that are awaiting custom clearance. It is generally at a place near a port and is licensed to keep the imported goods until custom duty is paid and clearance is given to them. The bonded warehouses are now present in all developed countries and many developing countries.

There are following benefits of a bonded warehouse:

- The goods kept in the warehouse are safe and hence importer gets the time to arrange for the customs duty meanwhile.
- If the goods are not required immediately, they can be kept in bonded warehouse for some time.
- The importers are allowed to mix, divide, re-label the goods inside the bonded warehouse, hence it allows to make the goods suitable for marketing.
- The goods meant for re-export can also be kept in a bonded warehouse without bearing much financial expenditure.
- Goods kept in the bonded warehouse are accepted as a collateral security by the banks to disburse the loans.
- If the importer doesn't have his own warehouse, he can transfer the title of goods to someone else while the goods still being in bonded warehouse and then buyer can pay the custom duties to get the goods.

When goods enter a bonded warehouse, the importer and the warehouse proprietor incur liability under the bond. This liability that arises when goods enter the warehouse is cancelled when:

- Goods are exported or deemed to be exported.
- Goods are withdrawn to be supplied to a vessel or aircraft in international traffic.
- Goods are destroyed under customs supervision.
- Goods are withdrawn for consumption within the domestic country after payment of duty.

Types of Bonded Warehouses

Depending upon the country or region, there are various options for storage of gods in a bonded warehouse. Some of these are:

- Temporary storage premises - These are used for storing goods that enter the customs premises of the EU and await further approval.
- Type B customs warehouse - These are public customs warehouse. The administrator has the right to make the warehouse available to anyone who wants to store the goods.
- Type C customs warehouse - These are private customs warehouses. Only the administrator of the customs warehouse can store goods in such a warehouse. The warehouse keeper can store goods on behalf of others but he shall remain responsible for customs for the goods stored in such warehouses.
- Type D and E customs warehouse - Only the administrator is allowed to store goods in such warehouses. These are strictly private warehouses.
- Free warehouse - It is a public bonded warehouse under the control of customs. Anyone can store goods in such warehouses.

- Special economic zone - SEZ or a free zone is not a building but a location. It serves similar purposes as a free warehouse.

Benefits of using a Bonded Warehouse

Companies use bonded warehouses to legally and safely deliver their products to customers. Bonded storage is a secure storage and is under customs laws. The bonded goods are well taken care of and documented. Exporters prefer bonded warehouse facility not just for security but for other benefits:

- No duty needs to be paid until the item is released for delivery to the buyer, giving full control of payment to the importer. And, if the goods go unsold, they can be exported without having to pay the duty at all, as VAT is only paid when you sell your products and not on re-exported goods from the bonded warehouse. Some businesses report saving 25% to 30% off taxes.
- Restricted items are allowed to be stored. These items can be safely stored in bonded storage until they need to be sent out.
- Facilities are equipped to handle different types of storage. Good bonded storage can store any kind of product for as long as needed. A good example would be for perishable food items - there are freezers, dry containers, and other temperature controlled rooms available.
- You receive a bond on your items. When you store bonded goods, the warehouse authority will give you a bond which ensures that you won't face any monetary loss at the time of the release of the shipment after the payment of taxes, including VAT or GST.
- They offer additional logistics solutions. It's possible to have access to a complete logistics solution, as bonded warehouses are affiliated with freight forwarding companies who handle distribution, deliveries, and more.

Alternatives to a Bonded Warehouse

Although it is very safe and secure and has its own benefits, the bonded warehouses may have restrictions depending on the country it's located in.

For example, the country your warehouse is in may not have a reliable postal solution, or have access to established express couriers.

Also consider the current trade war between China and the US. With tariffs being imposed from both sides, those who manufacture and fulfill from China could be negatively impacted if they are importing their products directly to the US.

For such businesses, utilizing a warehouse that's located in a free port could be a better solution.

A good example of a free port is Hong Kong, which has many warehouse facilities and is considered one of the top shipping centers in the world.

A fulfillment center or warehouse in Hong Kong is good for you in the following scenarios:

- You want to save on duties and taxes. Hong Kong is very trade friendly in that there are no applicable import and sales taxes. Moreover, if you're shipping to the US, the Hong Kong

Policy Act is your friend. According to this Act, the US cannot impose any tariffs on your products / shipments unless their value is over $800 USD.

- You want to ship globally with ease. If your manufacturer is based in Southern China, it makes sense to send your goods to Hong Kong for fulfillment. Why? Thanks to its location, 100 airlines service Hong Kong, with direct flights to 220 destinations (not to mention over 50 cities in Mainland China), allowing you to have access to more shipping solutions with faster delivery times.
- The warehouses are well established and connected. Overheads are less, allowing you to save more. Also, their shipping costs are lower compared to other overseas warehouses.

Warehouse Operations

Warehouse operations are an integral part of a company's business strategy. Efficient warehouse operations can ensure that a company ships and receives vital stock in time for replenishment on store shelves or in manufacturing facilities. Efficient warehouse operations do not happen by accident, but through adherence to a series of best practices initiatives.

Receiving

The receiving dock is the first place a company can begin to ensure an efficient warehouse. A receiving clerk should be in charge of receiving and securing all inventories and should also collect all shipping documents from the carrier at the time of delivery. A receiving log should be maintained to ensure that all inventory expected for the day has been received. The receiving log can be a useful source of information for other departments within the company, such as purchasing and accounting. All inventory received by the shipping clerk should be moved from the receiving dock to its appropriate place in the warehouse to prevent damage and deter theft.

Inventory Movement

The movement of inventory throughout the warehouse should be done by experienced materials handlers with certifications or licenses to operate forklifts and boom lifts. These materials handlers

should be able to move from one section of the warehouse to another with ease due to aisles that are not full of unstored inventory. Inventory that has not been placed in its proper bin or warehouse location can cause problems with inventory systems, especially under a FIFO, or First In, First Out, inventory system. A FIFO system ensures that the inventory that was received yesterday is moved to the shipping dock before the inventory that was received today. This inventory system reduces the chance of obsolete inventory sitting in warehouse bins.

Shipping

A company should ensure that the inventory being shipped out of the warehouse facility is secured until it is loaded onto the carrier's truck. The warehousing manager should consider a risk-based approach to shipping dock procedures, put more security on items that are of higher value or are easier to steal. A more intense effort to secure inventory should be made on shipping docks where the risk of theft or spoilage is highest. Only authorized personnel should be permitted to access the shipping dock. Companies can enforce this through the use of identification and swipe cards to access certain areas of the warehouse and shipping docks to ensure that inventory is secured until time for shipment. As with the receiving period, all documentation received from the carrier should be collected and the shipments should be recorded in a shipping log.

Warehouse Safety

The safety of warehouse employees should be paramount on the facility manager's checklist. Aside from providing employees with essential safety gear, management should adhere to the best practice of not permitting horseplay on warehousing equipment. As mentioned in the inventory movement section, all equipment operators should be certified and licensed, and tested for competence on a regular basis. Adherence to best safety practices helps to keep the company free of unnecessary legal action and prevents the assessment of fines and penalties.

Warehousing Models

Examples of models that have been presented in the literature or have been developed recently, to illustrate the application of operations research techniques for the planning of warehousing operations.

Inventory management/production planning decides which products are to be stored in the ware house and in what quantities. Storage location assignment decides where the products are to be stored. Here we may distinguish between a forward and a reserve area while also the basic storage policy in S/R systems is determined (e.g. dedicated class-based or random storage). First, we discuss inventory management.

Reduction of Inventory Levels

Intelligent inventory management/production planning may reduce the inventory levels and thereby the operational costs for storage/retrieval and order picking. Inventory reductions may be established by having smaller ordering quantities delivered more frequently. However, the total storage space needed may still be considerable if all deliveries occur at the same time. Hence, we may further reduce the need for storage space by care- fully scheduling the deliveries. Ultimately,

products from incoming trucks are immediately transferred to outgoing trucks, a phenomenon known as cross docking.

Classical inventory management and production planning models determine ordering and production policies for a single product. Hadley and Whit in consider inventory models for multiple products with a constraint on the total storage space. They determine ordering policies for all products which minimize the long-run inventory holding and ordering costs per unit time by solving the following problem:

$$\text{Min} \sum C_j D_j + A_j D_j / Q_j + r C_j Q_j / 2$$

s.t

$$\sum f_j Q_j = F,$$

where D is the demand rate in units per year for product j, A the fixed ordering costs for product j, C the unit variable purchase costs for product j, r the annual inventory carrying cost rate, Q the order quantity for product j, f the amount of space occupied by one unit-load of product j, and F the available storage space.

If the unconstrained solution exceeds the avail- able storage space, then a Lagrangian multiplier technique is used to find the optimal ordering policies. Here, the storage space estimation is based on the possibility of receiving all deliveries at the same epoch. However, by properly staggering the deliveries in time, the peak demand for warehouse space may be moderated. The combined problem of order sizing and delivery staggering is known as the Economic Warehouse Lot Scheduling Problem (EWLSP).

All models discussed so far assume fixed cost parameters, a constant demand rate, no delivery lead times and no backlogging. Clearly, the problem of order sizing and staggering deliveries becomes much more complicated in a stochastic setting. Suppose for example that pallet loads for each SKU are ordered according to a (continuous review) (s, Q)-policy (cf.). Under certain conditions, the number of pallets per SKU is uniformly distributed at an arbitrary point in time. Assuming stochastic independence of the demands for different SKUs, the total number of pallets can then be approximated by a normal distribution. Hence, under a random storage policy, the necessary storage space is determined by specifying a probability on stock overflow (cf.). However, under rigid space restrictions, the orders for the different SKUs are no longer independent. Besides, many ware- house managers follow a can-order policy (cf.) for groups of products to be delivered by the same supplier, thereby taking advantage of shared fixed costs or combined transport facilities. Hence, in such a situation, various orders of different SKUs arrive at the same time.

Storage Allocation and Assignment

A popular approach to reduce the amount of work associated with order picking is to divide the warehouse into a forward area and a reserve area. The forward area is used for efficient order picking. The reserve area holds the bulk storage and is used for replenishing the forward area and for picking the products that are not assigned to the forward area. The forward and reserve area may be distinct areas within the warehouse or the forward and reserve area may be located in the same

(pallet) rack. In the latter case, the lower levels represent the forward area, the higher levels represent the reserve area. In some facilities the reserve area is once again subdivided into two separate areas: one for order-picking and one for replenishing.

The forward-reserve problem (FRP) is the problem of deciding which products should be stored in the forward area and in what quantities. If a product is not assigned to the forward area, then it is picked from the reserve area. Hackman and Rosen- blatt describe a heuristic for the FRP that attempts to minimize the total costs for picking and replenishing. Frazelle et al. incorporate the heuristic into a framework for determining the size of the forward area together with the allocated products. The costs in the model for picking in the forward area and for replenishing depend on the size of the forward area.

Van den Berg and Sharp focus on operations that observe busy and idle periods. In these operations, it is possible to reduce the number of replenishments in busy periods, by performing replenishments in the preceding idle periods. This not only increases the throughput during the busy periods, it also reduces possible congestion and accidents. A typical example is a distribution center in which trucks are loaded during the afternoon, so that the workforce is available in the morning hours for replenishing the forward area. The authors consider a picking period during which the order-picking operation takes place. Prior to the picking period, the forward area is replenished in advance. Their objective is to find an allocation of product quantities to the forward area, which minimizes the expected labor time during the picking period.

The authors consider a situation observed in many operations (e.g. pallet storage), where unit loads is replenished one at the time. They use the following notation:

S set of products assigned to the forward area,

P_i random variable representing the number of picks for product i during the picking period, $i = 1,\ldots, N,$

R_{ij} random variable representing the number of concurrent replenishments for product i, if the forward area contains j unit-loads of product i at the beginning of the picking period,

$$i = 1,\ldots, \mathrm{N}, \mathrm{j} = 1,\ldots, m_i,$$

U_i random variable representing the number of unit-loads of product i that is needed to fullfill demand during the picking period.

The expected number of picks from the forward area and the reserve area are given by expressions below:

$$\sum_{i \in S} E\left(P_i\right),$$
$$\sum_{i \notin S} E\left(P_i\right).$$

Let z_i denote the number of unit-loads of product i that is stored in the forward area at the beginning of the picking period. Accordingly, the expected number of concurrent replenishments is given by expression:

$$E\left(R_{iz}\right) = \sum_{k=z+1}^{\infty} \left(k - z\right).P\left(U_i = k\right)$$

$$= \sum_{k=z+1}^{\infty} P(U_i \geq k)$$

$$= E(U_i) - \sum_{k=1}^{z} P(U_i \geq k).$$

Subsequently, they formulate the FRP as the binary programming problem (B-FRP), using the following notation:

m_i number of unit-loads available of product i, $i = 1,...,N$,

p_i $E(P_i)$,

u_i $E(U_i) - P(U_i \geq 1)$,

u_{ij} $P(U_i \geq j), i = 1,...,N, j = 2,...,m_i$,

V available storage space in the forward area,

T^{pf} average time for performing one pick from the forward area,

T^{pr} average time for performing one pick from the reserve area $\left(T^{\text{pr}} > T^{\text{pf}}\right)$,

T^{cr} average time for performing one concurrent replenishment.

They define decision variables y_{ij} for $i - 1,...,N, j = 2,...,m_i$.

$$x_i = \begin{cases} 1 & \text{if product i is assigned to the forward area,} \\ 0 & \text{otherwise.} \end{cases}$$

$$y_{ij} = \begin{cases} 1 & \text{if the } j \text{ th unit} - \text{load of product } i \text{ is replenished in advance,} \\ 0 & \text{otherwise.} \end{cases}$$

(B-FRP)

$$\text{Min} \sum_{i=1}^{N} \left\{ T^{\text{pf}} p_i x_i + T^{\text{pr}} p_i (1 - x_i) + T^{\text{er}} \left(u_i x_i - \sum_{j=2}^{m_i} u_{ij} y_{ij} \right) \right\},$$

s.t

$$\sum_{i=1}^{N} v_i \left(x_i + \sum_{j=2}^{m_i} y_{ij} \right) \leq V,$$

$$y_{i2} \le x_i, \qquad i = 1,...,N,$$
$$y_{ij} \le y_{i(j-1),} \qquad i = 1,...,N, j = 3,...,m_i,$$
$$x_i \in \{0,1\}, \qquad i = 1,...,N,$$
$$y_{ij} \in \{0,1\}, \qquad i = 1,...,N, j = 3,...,m_i.$$

The objective function follows from expressions previously explained after substituting pi, ui and uij and multiplying each term with the corresponding labor-time average. Constraint $\sum_{i=1}^{N} v_i \left(x_i + \sum_{j=2}^{m_i} y_{ij} \right) \le V$ stresses that the space occupied by the unit-loads allocated to the forward area may not exceed the available space. The remaining set of constraints $y_{i2} \le x_i, \quad i = 1,...,N$ and $y_{ij} \le y_{i(j-1),} \quad i = 1,...,N, j = 3,...,m_i$ allows the jth unit-load of product i to be stored in advance, only if unit-loads $1,...,(j-1)$ of product i are assigned to the forward area, for $i = 1,...,N.$

Storage Location Assignment

The storage location assignment problem (SLAP) concerns the assignment of incoming stock to storage locations. For automated storage/ retrieval systems, Hausman et al. present three storage location assignment policies: class-based storage randomized storage and dedicated storage. The *class-based storage* policy distributes the products, based on their demand rates, among a number of classes and reserves a region within the storage area for each class. Accordingly, an incoming load is stored at an arbitrary open location within its class. The class-based storage policy and the dedicated storage policy attempt to reduce the mean travel times for storage/retrieval by storing products with high demand at locations that are easily accessible.

Van den Berg presents a polynomial time dynamic programming algorithm that partitions products and locations into classes such that the mean single command cycle time is minimized. The algorithm works under any demand curve, any travel time metric, any warehouse layout and any positions of the input station and output station. We use the following notation:

Q_i independent random variables representing the number of unit-loads present of product i at an arbitrary epoch,

P_k set of products in class $k = 1,...,\mathrm{K}.$

Due to the demand and supply processes the inventory level fluctuates. We estimate the storage space requirement such that the storage space in every class suffices for at least a fraction $0 < \alpha < 1$ of the time. In other words, the probability of a stock overflow is less than $1 - \alpha.$ Let $\mathrm{Q^k}$ be a random variable representing the inventory level of class k at an arbitrary epoch, i.e. $Q^k = \sum_{i \in P_k} Q_i.$ Now, we want to find the smallest size Sk for the class-region of class k such that:

$$P\left(Q^k \le S^k\right) \ge \alpha.$$

Let t_j^{in} denote the travel time between the input station and location j and let t_j^{out} denote the travel time between the output station and location j. Every stored unit-load is retrieved some time later,

so that over a long time period half of the single command cycles are storages and half are retrievals. Accordingly, the mean single command cycle time to location

$$j \in L \text{ equals}: \frac{1}{2}\left(2t_j^{\text{in}} + 2t_j^{\text{out}}\right) = \left(t_j^{\text{in}} + t_j^{\text{out}}\right).$$

The single command cycle time, *E*(SC), is defined as:

$$\text{E(SC)} = \sum_{k=1}^{K} \frac{\sum_{i \in P_k} E\left(D_i\right)}{\sum_{i \in P_k} E\left(D_i\right)} \cdot \sum_{j \in L_k} \frac{\left(t_j^{\text{in}} + t_j^{\text{out}}\right)}{\left|L_k\right|},$$

where L_k denotes the set of storage locations of class *k*.

The first factor represents the probability that a request concerns class k. The second factor represents the mean travel time to a location in class k. In order to minimize the expected single command cycle time, we assign the products i that constitute the largest demand per reserved space and the locations j with the smallest $\left(t_j^{\text{in}} + t_j^{\text{out}}\right)$ to the first class and we assign the products i that constitute the next largest demand per reserved space and the locations j with the next smallest $\left(t_j^{\text{in}} + t_j^{\text{out}}\right)$ to the second class, and so on. Accordingly, the locations are ranked according to non-decreasing $\left(t_j^{\text{in}} + t_j^{\text{out}}\right)$ and the products are ranked according to non-increasing demand per reserved space.

We define gk (p, l) as the contribution of classes $1,\ldots,k$ to $\text{E(SC)} = \sum_{k=1}^{K} \frac{\sum_{i \in P_k} E\left(D_i\right)}{\sum_{i \in P_k} E\left(D_i\right)} \cdot \sum_{j \in L_k} \frac{\left(t_j^{\text{in}} + t_j^{\text{out}}\right)}{\left|L_k\right|}$,

when products $1,\ldots,p$ and storage locations $1,\ldots,l$ are distributed among these classes such that gk(p, l) is minimal. Then gk(p, l) satisfies:

$$g_k\left(p,l\right) = \min_{1 \le i \le p, 1 \le j \le l} \left\{h_{i+1,p}^{j+1,l} + g_{k-1}\left(i,j\right)\right\},$$

where $h_{i+1,p}^{j+1,l}$ denotes the contribution to $\text{E(SC)} = \sum_{k=1}^{K} \frac{\sum_{i \in P_k} E\left(D_i\right)}{\sum_{i \in P_k} E\left(D_i\right)} \cdot \sum_{j \in L_k} \frac{\left(t_j^{\text{in}} + t_j^{\text{out}}\right)}{\left|L_k\right|}$, if the products $i+1,\ldots,p$ and the locations $j+1,\ldots,l$ form one class k. Recalling that the number of locations required in each class is determined by $P\left(Q^k \le S^k\right) \ge \alpha$. the values gk(p, l) are found by iteratively solving the dynamic programming $g_k\left(p,l\right) = \min 1 \le i \le p, 1 \le j \le l \left\{h_{i+1,p}^{j+1,l} + g_{k-1}\left(i,j\right)\right\}$ Each gk(p, l) corresponds to an optimal solution of the sub problem with k classes and the first p products and the first l storage locations when ranked as indicated before.

We may use the algorithm to determine the optimal class-partition for $1,\ldots,k$ classes. Subsequently, the number of classes among $1,\ldots,k$ may be selected that constitutes an acceptable mean travel time and space requirement.

Green Warehousing

Warehousing (including inventory management) is one of the most critical supply chain functions, accounting for 20-25% of logistics costs. Traditionally warehousing operations involved receipt, storage and delivery of materials (raw materials, WIP, finished goods and packaging) across supply chain. However, with rising costs and increasing customer demands, the role of warehousing has shifted to providing value added services. Today warehousing operations involve break-bulk, product mixing, reverse logistics, cross-docking, late product differentiation and just in time & customized deliveries, thereby helping companies to achieve operational efficiency and high levels of customer satisfaction.

However, warehousing operations involve inputs related to energy, fuel, land and buildings. Apart from impact on firm level performance, they also affect the local environment and society in form of atmospheric emissions, waste generation and noise pollution. In order to develop sustainable warehousing operations, it is essential for companies to explore and implement green initiatives.

Lighting, HVAC system and material handling equipments are the largest energy users in warehouse operations. It is estimated that best warehouse energy management practices can save 40-50% of energy use without significant capital investment. Companies can adopt following means for reducing their environment impact without significant cost burden.

- Daylighting: Natural lighting involves installation of skylights and clerestory windows which provide natural illumination in warehouses with minimum additional construction. Companies can also use light tubes made of highly reflective material to harness natural light. As natural light intensity varies across the day, a hybrid setup involving natural means and artificial lights can be used. Natural lighting, thus helps companies to reduce electricity usage, reduce carbon dioxide emissions and improve environment quality for warehouse employees.
- Lighting systems: Often warehouses are overlit, resulting in unnecessary energy wastage. This can be overcome by using motion sensors, especially in low traffic or non-crucial areas, which ensures that lights are turned on only when the area is in use. Moving lighting away from ceiling and closer to workers can also help reduce overall usage. Fluorescent lights can be used in place of traditional metal halide light fittings. These lights are suitable for intermittent operations and provide same amount of light with lower energy consumption (up to 50% less compared to traditional fittings) at cost effective prices.
- Warehouse Management: Proper warehouse management can eliminate unnecessary and repetitive operations which can reduce energy and fuel consumption. For instance, high density areas due to large product quantity in small spaces result in multiple use of forklifts. Lack of streamlined operations result in multiple handling of products making the material flow critical for ensuring energy management. Use of inventory tracking techniques like RFID can help eliminate unnecessary material handling activities, resulting in savings on energy and fuel front. Vertical warehousing (racking & storage) and vertical equipment like vertical carousels & conveyors can help companies reduce land requirement, reduce construction footprint and achieve better facility planning & higher space

utilization. This helps companies in preserving natural resources, develop energy efficient buildings, reduce energy costs and overall carbon footprint.

- Material handling equipment: Energy efficient equipment like battery-operated or fuel cell forklifts eliminate emissions and produce less noise during operations as compared to fuel operated ones. Automation systems can be developed so that parts of system shut down automatically when not in operation. For instance, sensors can be put which detect incoming products and accordingly start conveyors. This helps in extending equipment's' life cycle, improve operating efficiency and reduce power consumption.
- Green Envelope: Green envelope involves building warehouses with energy efficient walls and roofing systems. Energy efficiency of walls can be improved up to two times by replacement of traditional batt insulation with loose-fill or sprayed foam. Roofing systems' energy efficiency can be improved by replacing the traditional black coloured rubber roofing membranes with reflective roof membranes like white thermoplastic polyolefin roofing. However, white roofs are justifiable for building new roofs. For existing roofs, highly reflective paints can be used which can reduce the amount of heat absorbed by the building.
- Temperature Control: Optimum warehouse temperature is critical for ensuring product maintenance in industries like pharmaceuticals, agro-products etc.. Apart from product quality it also helps in regularizing energy requirement. It is estimated that a 1 oC decrease in internal warehouse temperature can lead upto 10% energy consumption savings. Like residential and commercial buildings, controllable thermostats can be deployed in warehouses which can regulate the warehouse temperature and reduce energy usage with short heating and cooling cycles. Use of high volume low speed (HVLS) fans can also regulate warehouse temperature. HVLS fans allow warehouses to increase or decrease thermostat temperature settings between 3-5 degrees without any negative temperature changes which can result in savings of 10-20% in heating and cooling costs.

Green warehousing provides significant opportunities for companies to decrease their operational costs, while simultaneously reducing the environmental and social impact of their operations, thereby building a sustainable ecosystem. In a long term, companies should target for net-zero warehouses which would involve generating as much energy as much is consumed. This involves a gradual transition, with initial target of achieving optimal energy performance through cost effective practices and then shifting to a renewable energy strategy like photovoltaic solar panels, thus ensuring long term sustainability.

Green Technology is the wave of the future. Whether it be taking a more eco-friendly or environmental approach or featuring the latest improvements in logistics, supply chain, or warehousing interfaces, there are an abundance of benefits to adopting and adapting a green approach. Are you looking for ways to integrate these practices into your material handling operations? Are you seeking manners to ride the wave of the future in green technology? There are many steps you can take to do just that. Whether it is increases in automation or recycling, or efficient warehouse designs, these initiatives are proven to bolster a wide range of enhancements to your business. Here is how you can go green with your logistics and warehousing.

Implement and Integrate Automation

Automation is the modern age coming soon to a warehouse near you. Artificial intelligence does not replace the human touch but instead optimizes it. By committing your personnel to more prudent and compulsory tasks, artificial intelligence can pick up the slack. Furthermore, automation makes those routine chores and operations done more expediently, efficiently, and effectively. What is monotonous to a person is simple to automated mechanisms. Therefore, implementing and integrating these devices is a great way to ride your logistics and warehousing endeavors straight into the future.

Utilize Ergonomic and Efficient Warehouse Designs

With the emergence of Kaizen, LEAN, Six Sigma, and Agile methodologies, ergonomics has stormed to the forefront of material handling and supply chain operations. Now, efficient warehousing designs take these ideologies and approaches on board and bring them into the daily grind. Thanks to performance analytics and metrics, your network infrastructure can do all the leg work while you invent new ways to make the most out of logistics. Whether it be space maximization, improved transportation routes, or smarter personnel management, efficient warehouse designs integrate these ergonomic principles to ensure your business sees the most gains with the lowest possible losses. This is also done through identifying, isolating, and eliminating bottlenecks in your set-up.

Improve Recycling

There is not a more fundamental green behavior than improving one's recycling initiatives. Astoundingly, many do not garner such a progressive attitude to such a routine and simple task. In fact, the carbon emissions accumulated across the supply chain can account for up to 60% of the total carbon footprint left by humans on a regular basis. Implementing recycling can help reduce that carbon footprint. According to ILMM, the bare minimum an organization can do to implement green practices is the installation of a good, efficient, and methodical recycling system. When a business dispenses garbage to landfill, more often than not valuable resources go to waste. The good news is that recycling is easy to get started by simply acquiring and using recycling bins across the premises. Following this up with a training and education for employees in appropriate practices can get any recycling initiative up and running very quickly.

Digitize your Supply Chain

By digitizing your supply chain, you are contributing to the green movement. Using innovative interfaces such as SAP, you can optimize your inventory, enhance material control, and determine areas of improvement in existing operations whilst reducing the carbon footprint. As you ride the wave of the future, you can also obtain a landscape view of the entire supply chain across vast and global business units. Doing so makes it easier to scrutinize and analyze every facet of the operation to identify, isolate, and amend deficiencies. All this can be done with the push of the button and reduces the need for paper-based audits and over manned hours. The effects of this bolsters efficiency, productivity, and profitability as overhead costs are also slashed. All this done while also contributing positively to the eco-system. Digitizing the supply chain is an emerging trend in the material handling industry and with a plethora of benefits; it is easy to see why.

Promote Continuous Improvement

Supply chains are complex in nature. Thus, it may seem endless when finding ways to improve it and make it eco-friendlier. However, there is one philosophy that seems to stand above all others: lifecycle evaluation. It goes beyond achieving certification ISO 1400, it is a progressive mindset that encourages businesses to think outside the box at every phase of the operation. Whether it be adopting vendors who are like-minded, finding ways to procure the raw goods without using renewable energies, or utilizing other technologies to slash the amount of pollutants or harmful bi-products, there are always new ways to make your supply chain and logistics programs better. This is especially true when it comes to going green. Just as we have seen new nuances take the forefront in safety awareness to render previous schools of thought obsolete, the same scenarios are unfolding in supply chain management. The best way to stay up to date is to promote a workplace that is transformative and committed to continuous improvement. In doing so, employees can become more interactive and collectively the organization can collaborate in devising new ways to be kinder to the environment. Continuous improvement is more than just an idea; it's a way of life. Green technology is a result of such an attitude.

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