Module 4 (Inventory Space Management Module)

CLUSTERING OF WAREHOUSES (DIVISION BY SPECIALIZATION) –

Parameters for deciding location of a specific warehouse –

- Place warehouse of certain products at locations where demand is predicted to be max (via demand forecasting)
- Place warehouse near shipping ports for ease in inbound and outbound logistics
- Place warehouse in places which are not prone to lockdown (AI can help in predicting this)
- Place warehouses in places which are not prone to natural disasters (AI can help in predicting this)

Specialization of warehouses based on products –

A Complete Guide to All Types of Warehouses (Part 1) (cyzerg.com)

6 Types of Warehouse Storage Systems - Camcode

- Place warehouses of certain group of products by leveraging the category of products against different factors such as weather conditions – For example keep waterproof products in places where there is a lot of rain (AI can help in this kind of intelligent decision making) or maybe unaffected by some natural disasters (such as do not keep food items that have a chance of locust infection).
- Specialized warehouses for food products -
  a) For packaged foods temperature and humidity control not required, human workers with simple machines and forklifts enough (robots would be worse as there would be a variety of items and chance of error should be low as these items are usually not deemed returnable).

  b) For fresh foods proper refrigeration, temperature and humidity control required. On top of that a lot of insurance costs are to be beared, overall recurring fixed costs are high. So, they must be highly specialized. Extensive cleaning required. Away from industrial and hazardous areas but should be kept close to populated and high demand areas for freshness and lower refrigeration cost during transportation. (AI can help in this intelligent decision making).

- Specialized warehouses for pharma products -
  a) Humidity and temperature control, keep less windows as (cool and dark place storage required). Automation can be done as glass bottles need to be handled carefully and would be done better by machines as there are also proper serial packaging involved with each and high product differentiation is resent so robots can be specialized accordingly according to the

shapes and sizes of the bottles and medicines.
Can be packed densely as no requirement of aeration or keeping fresh. Proper keeping track of time till expiry date must be maintained and AI must accordingly determine which bottle of medicine should be chosen to be sold in the inventory and determine their place in the warehouse from before based upon future demand prediction.

- For **Convenience products** since they are essential goods and people buy them frequently and do not think so much, stick to their routine buys only, this process should work like clockwork. For these types of goods people **do not need a "feel"** for the product as they are already familiar with it. So, **offline channels not required**. Also, they are very less varying and routine sales happen almost every month regardless of external situations. So, **full automation** can be done in this types of warehouse as not much intelligent decision making required and machine can do such routine things properly and fast. Warehouses must be located very near **high demand locations** because these products have **high sales** (and so **variable costs related to shipping** must be **kept low**). **Eg (Tata Salt).**
- For **shopping goods** (furniture, TV, etc), people need to have a look and feel for the product, so offline channels required. Since the sales are not that fast, warehouse automation not much required. Also, product differentiation is high and things may be fragile. **So, humans would be better suited along with semi automation.**
- For speciality goods, people go more on **brand value and reputation about historic things**. So, people have blind belief on the product and would buy even **without having a feel for it**. So, **offline channels are not so necessary**. Low price sensitivity, so companies can go ahead even with not so much optimization and specialization. Warehouse placement for these types of goods need not be so much location based, but need to be **near global shipping points** since they must have demand for export also. **Warehouses should be suited more for this. Eg(Apple macbooks or Designer bags)**

Cost of warehousing in developing countries is more than that in developed countries. SO, selection of optimal warehouse locations is key.

Input variables can be given weights (like Fuzzy logic – "Absolutely important", "Very important", "Essentially important", "weakly important", "equally important"

Selection of warehouse location for a global supply chain: A case study - ScienceDirect

Input Variables list for Warehouse locations (AI would predict locations for better profits) –

Easy to Get – E ; Hard to Get Variable – H. Easy and hard decided based upon amount of research and cost required to get the necessary info to define the variable type.

- Types of Goods to be stored – which will further determine its specialization inputs such as size, structure, etc. (**Qualitatve, E)**
- Land cost in location **(Quantitative, E)**
- Whether location comes under Free Trade Zone or Special Economic Zone **(Qualitative, E)**
- Whether there are some concessions for some specific products **(Qualitative, E)**
- Favorable traffic conditions, proximity of rail and transport connections **(Qualitative, H)**
- Labor characteristics of the region (whether cheap labor available) **(Qualitative, H)**
- Climate **(Qualitative, E)**
- Government (Taxation criteria, incentives, legal guarantees, etc.) Special Economic Zones, Free Trade Zones,etc. **(Qualitative, H)**
- Bank and other monetary facilities in the region **(Qualitative, H)**
- Infrastructure development of region (cannot build highly specialized warehouses in very underdeveloped regions, example where electricity goes out too often or water is scarce, telecommunication, etc), IT Penetration **(Qualitative, H)**
- Infrastructure of Connectivity mediums in the region **(Qualitative, H)**
- Characteristics of market nearby (eg size, competition, scope for market growth) **(Quantitative,E)**
- History of extent of effect on area due to black swan events (example if area has a history of quickly contracting bird flu, etc), lockdown considerations **(Qualitative, H)**

Some of these factors are qualitative, some are quantitative. AI would help in qualitative ones where mathematical modeling is not so easy.

Output – Best choice location for a warehouse based upon all input factors

Input variables list for structural specialization of warehouses –

Warehouse design and layout: 6 basic factors – Mecalux.com

Warehouse Design: What are the Key Factors to Consider? (logisticsbureau.com)

- Budget **(Quantitative, E)**
- Type of good (and their properties-temperature sensitivity, weights, etc.) – ease of storing in racks, whether hazardous, fragile or require special handling. **(Qualitative, E)**
- Dimensions for material handling equipment (handcarts, forklifts) **(Quantitative, E)**

- Maintenance of these equipments **(Quantitative, E)**
- Product volume **(Quantitative,E)**
- Pareto's principle (keep the products that affect the sales the most in priority locations) **(Qualitatve,E)**
- Windows required or not, temperature, humidity control, refrigeration **(Qualitative, H)**
- Dimensions of goods **(Quantitative, E)**
- Power lines required (varies based upon automation) **(Qualitative, H)**
- Flow rate of goods **(Qualitative, E)**
- Personnel available **(Qualitative, H)**
- Whether a lot of returns happen **(Quantitative, H)**
- Company policies (focused more on customer service, unique product or low cost product) **(Qualitative, H)**
- Types of operations taking place inside (whether extra value added services done) **(Qualitative, H)**
- How will packages be stored (cartons, packets, pellets etc) **(Qualitative, H)**
- Seasonality of demand **(Qualitative, H)**

Output – Optimum Structural specifications of Warehouse

Warehouse Design Factors and considerations for each type of good (Convenience, shopping, speciality) -

	Convenience Goods	**Shopping Goods**	**Specialty Goods**
Description of Good	Essential goods, low cost, recurring sales every month, stable demand, people do not invest much time in deciding eg(TATA salt)	Pricier goods, sales less frequent, people invest more time in deciding, prefer to have a feel for the product eg(TV)	Luxury items, high brand value, loyalty, pricing power, reputation, "feel" not necessary, eg(Apple Macbook or Rolex submariner)
Product volume	Very high	Lower	Rare
Pareto's principle	Highly applicable (eg Maggi)	Not so much	Absolutely not
Automation requirement	Extremely high	Semi Automated	Company preference
Flow rate of Goods	Extremely high	lesser	least

Seasonality of demand	Not there	There (eg AC)	Not there
Tracking system requirements	Extremely modern, fast and optimized	Not so much	Simple tracking sufficient
Return possibility	Very less	Not negligible	Very less

For Essential Goods –

- Fast tracking system
- Extreme optimization of shelf size and space based upon products prioritized through Pareto principle
- High level automation for fast flows
- Good power supplies and backup
- May require temperature and humidity control
- Mixture of skilled and unskilled personnel
- Ease of access and storage
- Clear demarcation of entry and exit points (well connected with transport systems)

For Shopping Goods –

- Semi automatic tracking system
- Ability to deal with returns (dedicated section optimized according to previous data)
- Semi automated machines
- Ability to deal with Fragile items
- Skilled labour (as extra value adding activities may be done in inventory)