



CFCFA Logistics Management Training

Warehouse & Distribution Center

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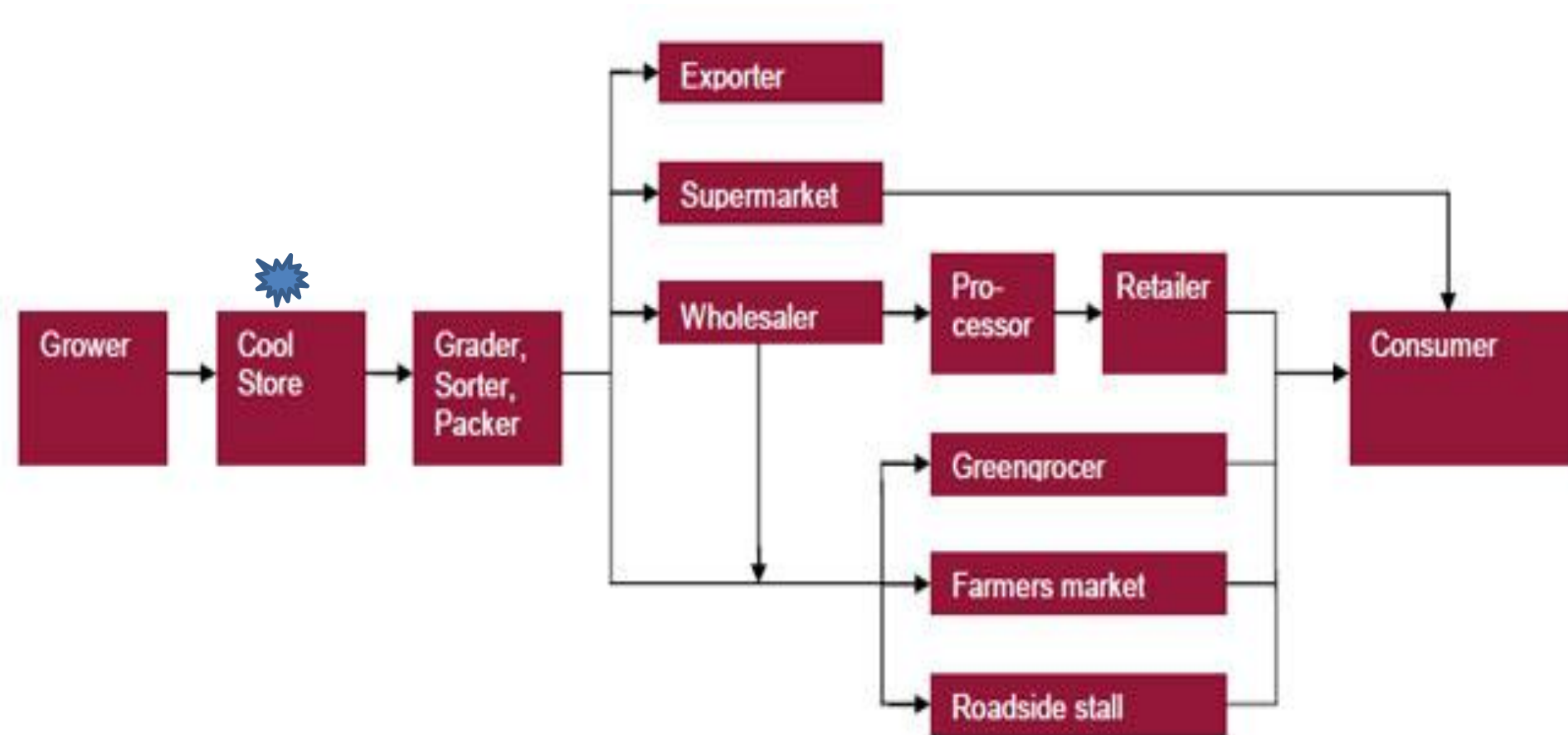
1. Warehouse and distribution center in supply chains
2. Role of inventory in supply chain management
3. Differences and similarities between warehouse & distribution center
4. Warehouse/distribution Center operations
5. Important warehouse/distribution center decisions
6. Temperature-controlled product storage and distribution
7. Proven approaches for generating extra profit
8. Warehouse bypass ideas
9. Future developments



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Warehouse and Distribution Center in Supply Chains

Fresh Fruit & Vegetable Supply Chain



Milk Supply Chain



Cows at a dairy farm are milked twice a day and the milk is stored in a refrigerated silo for up to 48 hours.



A refrigerated tanker collects milk from the dairy farm every 24 - 48 hours and transports it by road to a processing factory.



Milk is pasteurised and homogenised at the processing factory and is stored in refrigerated silo's before and after processing.



A refrigerated tanker transports the milk by road, from the processing factory to the manufacturer.



It is then transported in trucks by road to supermarkets and retail outlets.



Milk is packaged and loaded onto pallets and into a refrigerated truck.



Manufacturers produce dairy and other products from the milk.



Or transported by plane for world exports.



These products are loaded on to pallets and into trucks.



and transported by road to supermarkets and retail outlets.



These orders are then loaded on to pallets and into trucks,

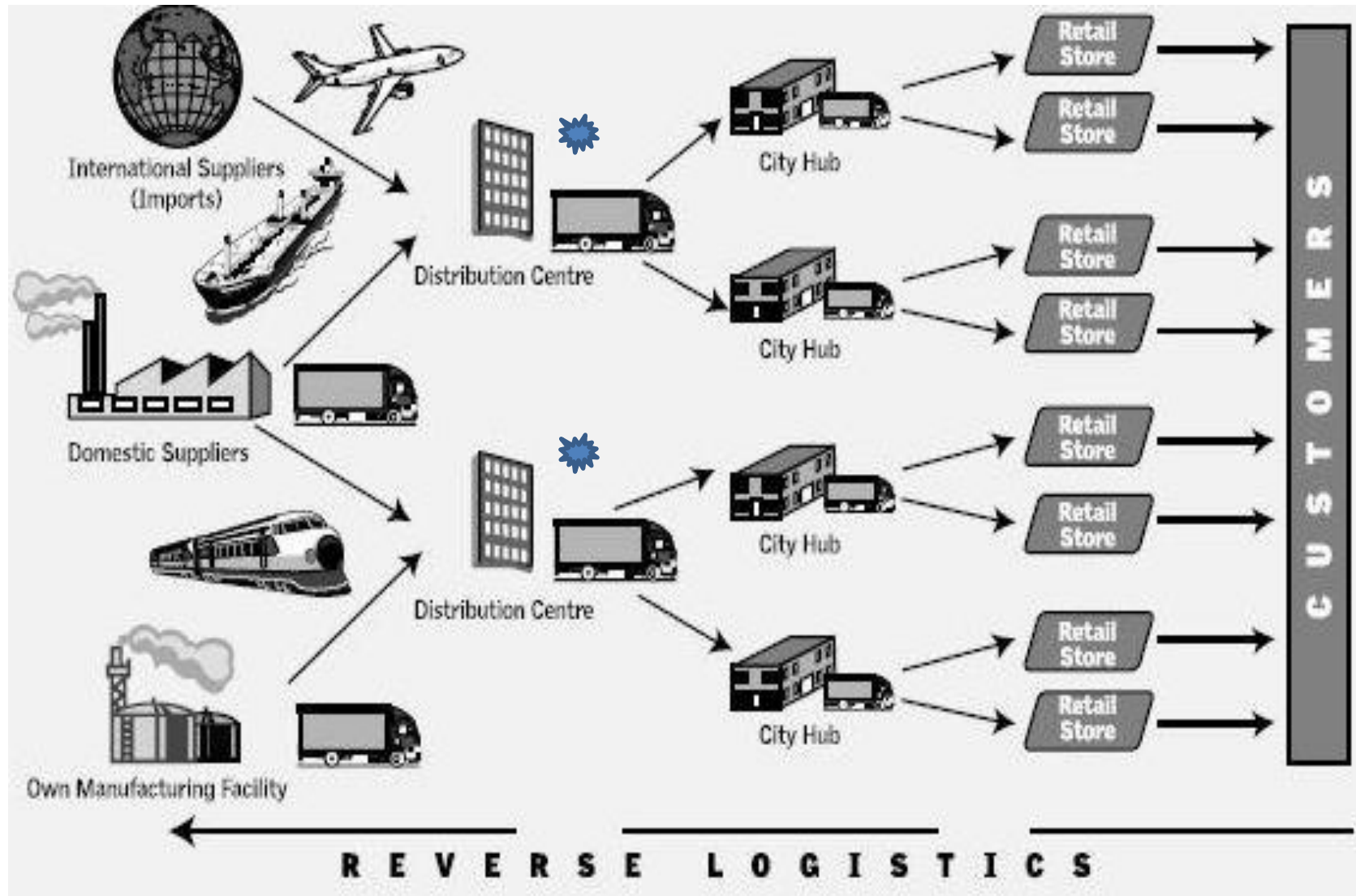


Trucks transport the products by road to a warehouse, where orders are assembled.



Products are then transported on plane for world exports.

A TYPICAL RETAIL SUPPLY CHAIN UTILIZING DISTRIBUTION CENTERS





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Role of Inventory in Supply Chain Management

Importance of Inventory Management

- Inventory is an asset on the balance sheet and an expense on the income statement.
- Inventory minimization reduces both expense and asset needed to operate a business, leading to higher return on asset (ROA) for the enterprise.
- ROA is an important metric for the efficiency of an enterprise.
- Higher ROA contributes to higher enterprise valuation.

Inventory due to Batching Economies

Batching economies arises from three sources

1. procurement
2. production
3. transportation

Scale economies are often associated with all three, which can lead to the accumulation of products in inventory that will not be used or sold immediately.

Uncertainty/Safety Stocks

- On the demand side, there might be uncertainty in when and how much the customers will buy
- On the supply side, there might be uncertainty about obtaining what is needed from suppliers and how long it will take for fulfillment of the order.
- Long and uncertain cross border time contributes to need for higher inventory level.

Seasonal Stocks

- Seasonality can occur in the supply of raw materials, in the demand for finished product, or in both.
- Those faced with seasonality issues are constantly challenged when determining how much inventory to accumulate.
- Seasonality can also impact transportation and cross border inspection, which in turn influence inventory level.

Anticipatory Stocks

- The need to hold inventory when an organization anticipates that an event might occur that will impact
 - Source of supply (e.g. port labor work stoppage)
 - Level of Demand (e.g. hurricane)
 - Forward product pricing

Sudden Supply & Demand Shocks

- A sudden surge in supply or drop in demand can cause products to accumulate until the supply chain can react to the change.
- Excess product must be stored so they can be sold later on.

Inventory Costs

Inventory Carrying Costs

- interest or opportunity cost

Inventory Service Cost

- includes insurance and taxes

Inventory Risk Cost

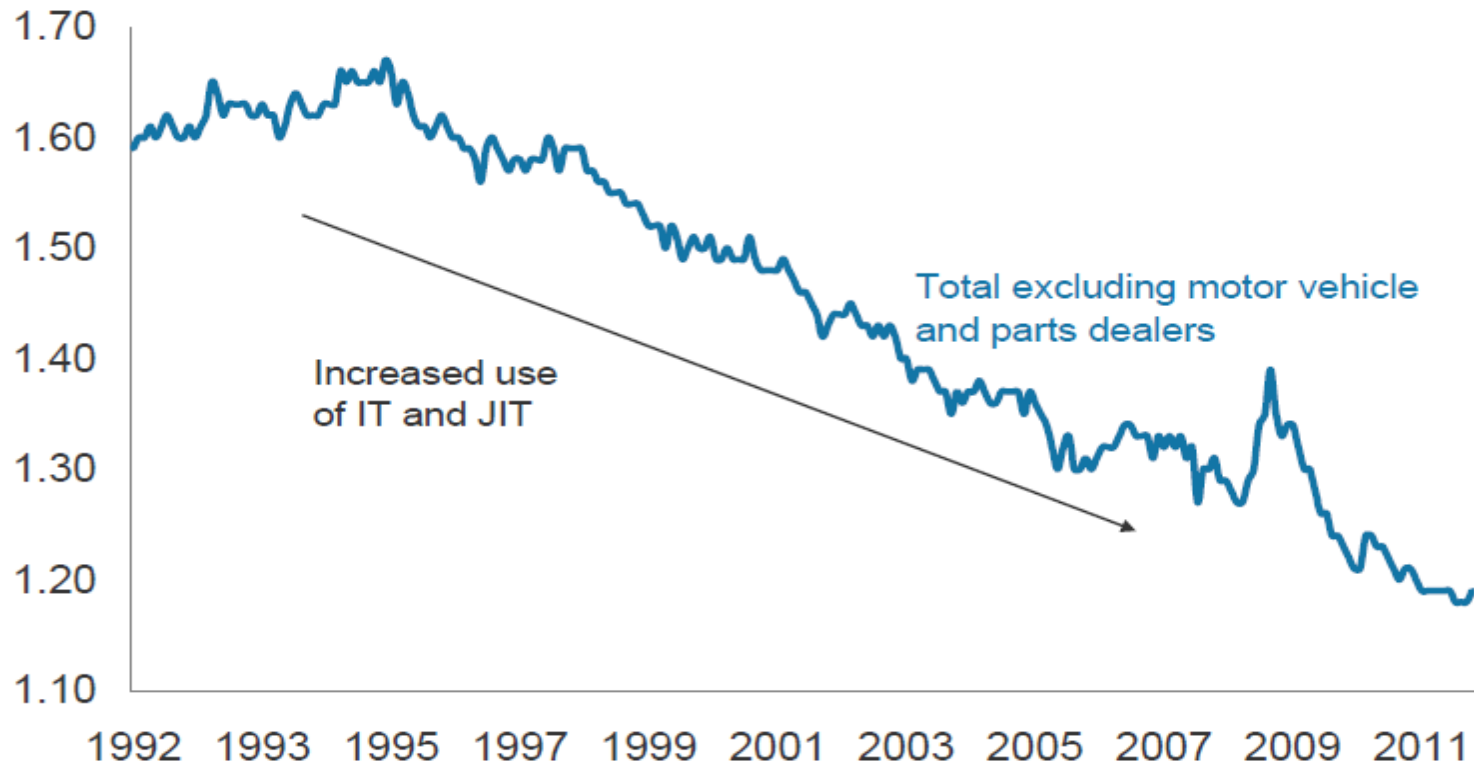
- reflects the possibility that inventory value might decline for reasons beyond firm's control (e.g. obsolescence)

Storage Space Cost

- includes handling costs associated with moving products into and out of inventory, as well as such costs as rent, heat, and light

US Retail Inventory/Sales Ratio Declined Through IT and JIT Development, 1992-2011

Inventory/Sales Ratio (Seasonally Adjusted)



The U.S. Business Logistics System Cost is the Equivalent of 8.5 Percent of Current GDP in 2011

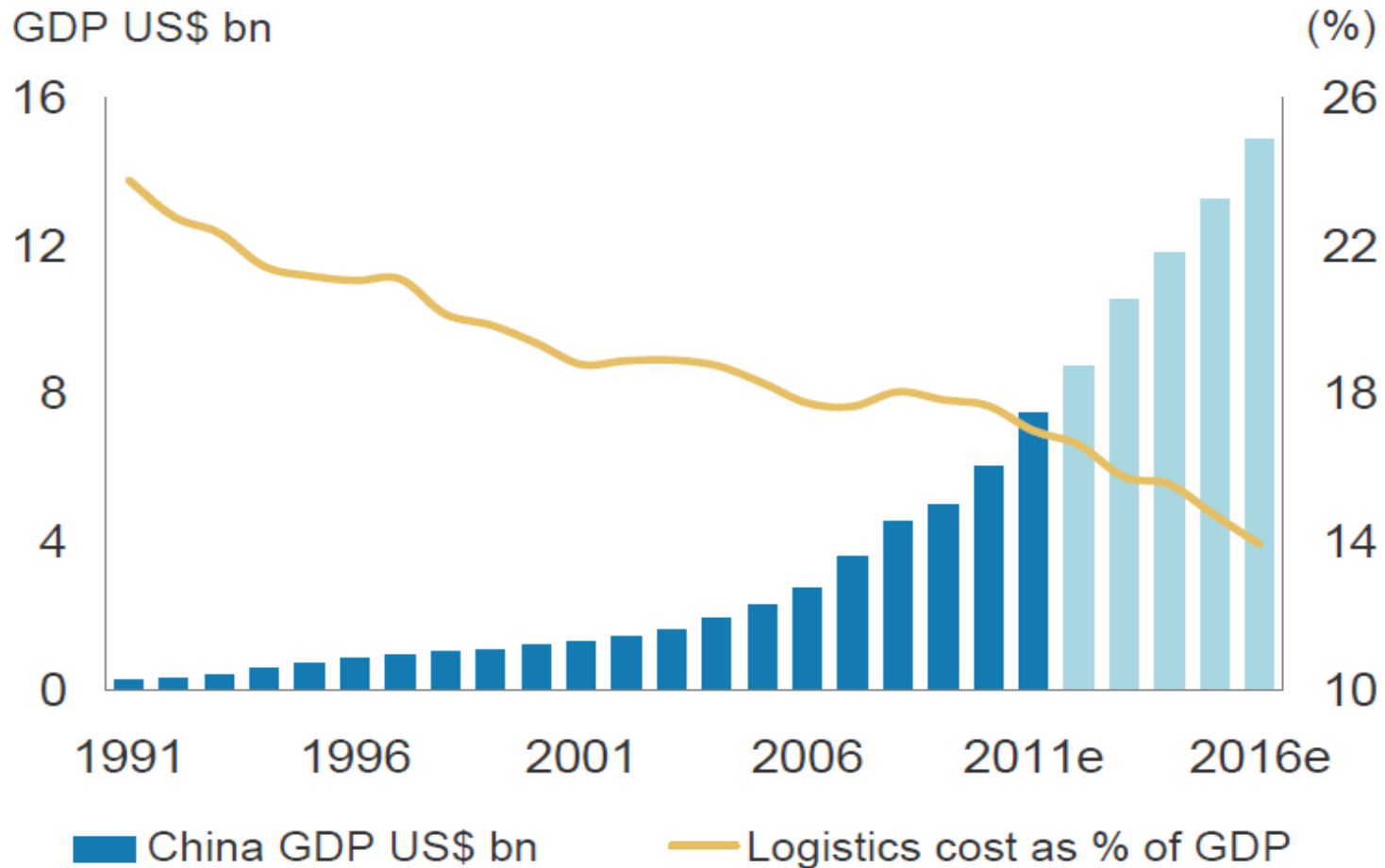
	\$ Billions
Carrying Costs - \$2.184 Trillion All Business Inventory	
Interest	3
Taxes, Obsolescence, Depreciation, Insurance	294
Warehousing	120
Subtotal	418
Transportation Costs	
Motor Carriers	
<i>Truck – Intercity</i>	431
<i>Truck – Local</i>	198
Subtotal	629
Other Carriers	
<i>Railroads</i>	68
<i>Water (International 28, Domestic 5)</i>	32
<i>Oil Pipelines</i>	10
<i>Air (International 16, Domestic 15)</i>	32
<i>Forwarders</i>	35
Subtotal	177
Shipper Related Costs	10
Logistics Administration	49
TOTAL LOGISTICS COST	1,282

Inventory
32.6%

Transport
62.8%

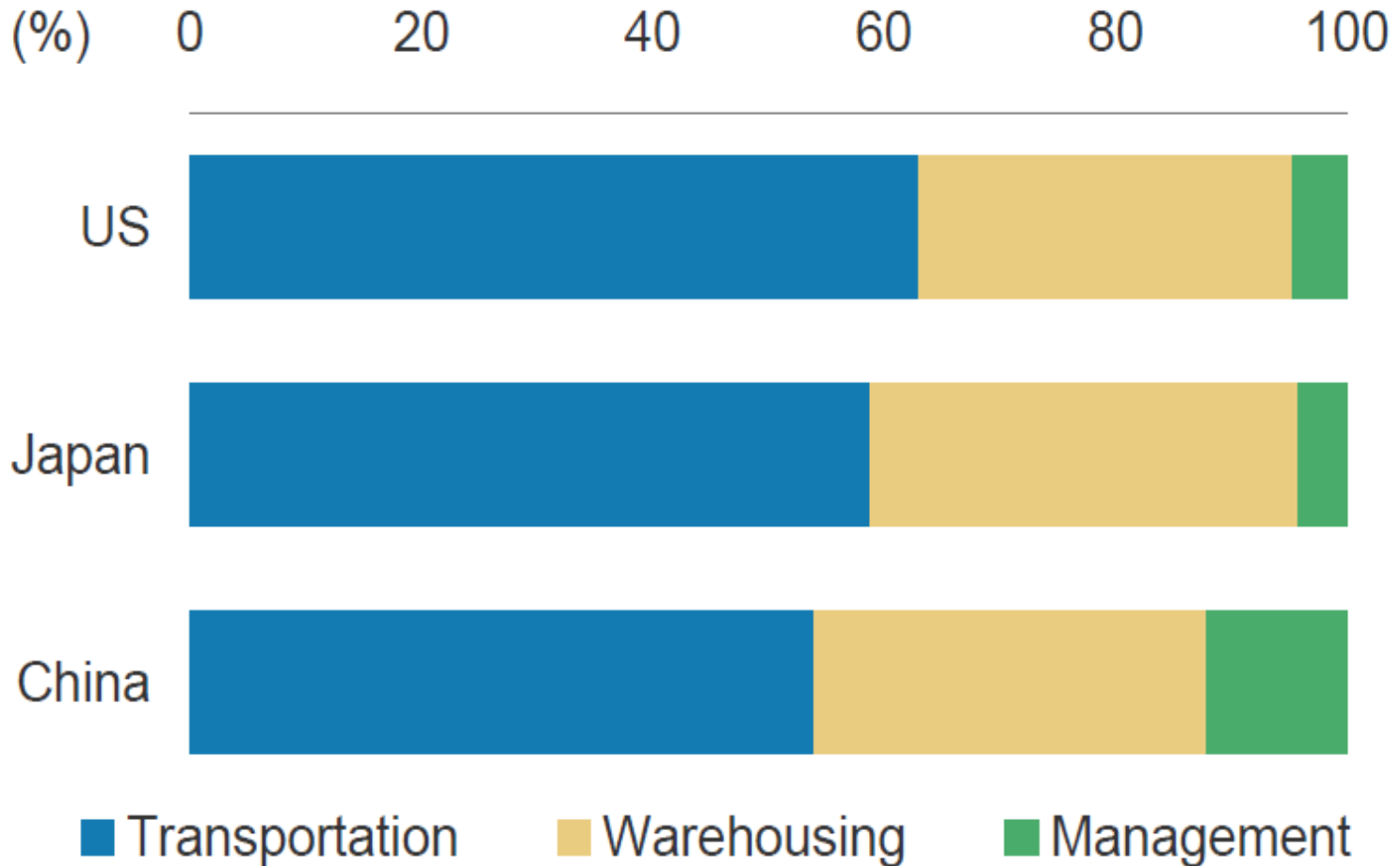
Administration
4.6%

China's Logistics Cost to GDP % Twice as High as US & Japan



e = Morgan Stanley Research estimates
Source: CASS, CEIC, IMF, Morgan Stanley Research

China's High Logistics Cost to GDP % is Attributable to its Warehousing & Management Cost Components





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Differences & Similarities between Warehouse & Distribution Center

Differences & Similarities between Warehouse and Distribution Center

Similarities

- Both have 4 walls, a roof and truck/rail docks

Differences

- Warehouse
 - Focused on the most efficient & cost effective methods of storing products within its four walls
 - Low inventory velocity
- Distribution Center
 - Principal link between suppliers and customers
 - Focused on filling customer orders
 - High inventory velocity
 - Variety of value added services (e.g. fulfillment, kitting)
 - Technology driven

Warehouse Functions

“Traditional stockpiling of inventory”

- Provide time utility shift. Sometimes used for speculation.
- Space for storage (e.g. documents, seasonal merchandise)
- Space for protection from environmental impacts (e.g. rain, heat, sun)
- Space for product characteristics change (e.g. wine aging)



Distribution Center Functions

“Rapid flow-through of products to customers”

- Fulfill wholesale and retail orders using state-of-the-art order processing, transportation management and warehouse management systems to pick/pack and process orders, as well as to plan and manage loads to customers.
- Serve as a high throughput cross-dock facility for sorting & consolidation to achieve economies of scale in outbound flows
- Short duration storage space

Wal-Mart Distribution Center near Chicago





Amazon's Book Distribution Center near Dallas



Highly Automated UPS Distribution Center Shipping Dock Next to BNSF Railway Multimodal Terminal





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Warehouse/Distribution Center Operations

Efficient Warehouse/Distribution Center Operations

Handling (receiving, transfer, shipping)

- Long continuous moves in lieu of short moves
- Larger loads over small loads
- Bypass storage, direct to shipping
- Intermediate storage on pallets prior to shelf stocking
- Process automation (WMS, conveyor systems, robotic systems)



Efficient Warehouse/Distribution Center Operations

Storage (slot location determines by product velocity, weight & characteristics)

- High velocity products closed to doors, main aisles and at lower storage rack levels
- Heavy items at lower storage levels
- Shelves, bins or drawers for small items
- Items placed to minimize picking errors
- Separate areas for incompatible items to avoid cross-contamination

ABC Inventory Analysis

Assigns inventory items to one of three groups according to the relative impact or value of the items

A items are considered to be the most important

B items are of lesser importance

C items are the least important

Determines degree of control and slot positions in warehouse/distribution centers

ABC Inventory Analysis

Derived from Pareto's Law, or the "80–20 Rule"

Simple illustration

A items: 20% of the items account for 80% of the consumption

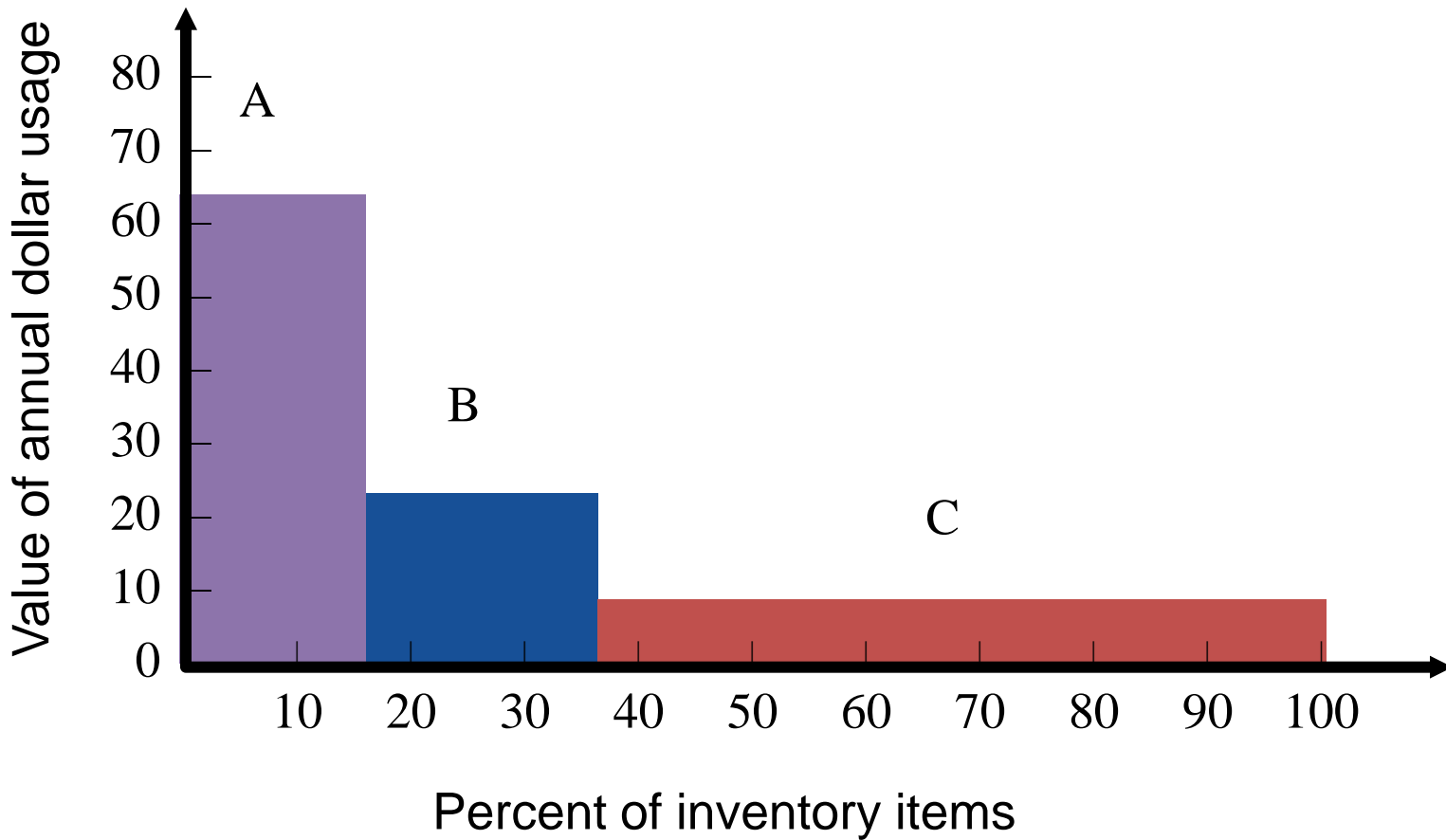
B items: The next 25% of the items account for 15% of the consumption

C items: The final 55% of the items account for 5% of the consumption

Example of ABC Analysis

Table 9-21		ABC Analysis for Big Orange Products, Inc.			
ITEM CODE	ANNUAL REVENUE	PERCENTAGE OF ANNUAL REVENUE	CUMULATIVE REVENUE	PERCENTAGES ITEMS	CLASSIFICATION CATEGORY
64R	\$ 6,800	68.0%	68.0%	10.0%	A
89Q	1,200	12.0	80.0	20.0	A
68I	500	5.0	85.0	30.0	B
37S	400	4.0	89.0	40.0	B
12G	200	2.0	91.0	50.0	B
35B	200	2.0	93.0	60.0	B
61P	200	2.0	95.0	70.0	B
94L	200	2.0	97.0	80.0	C
11T	150	1.5	98.5	90.0	C
20G	<u>150</u>	<u>1.5</u>	100.0	100.0	C
	<u>\$10,000</u>	<u>100.0%</u>			

Example of ABC Analysis



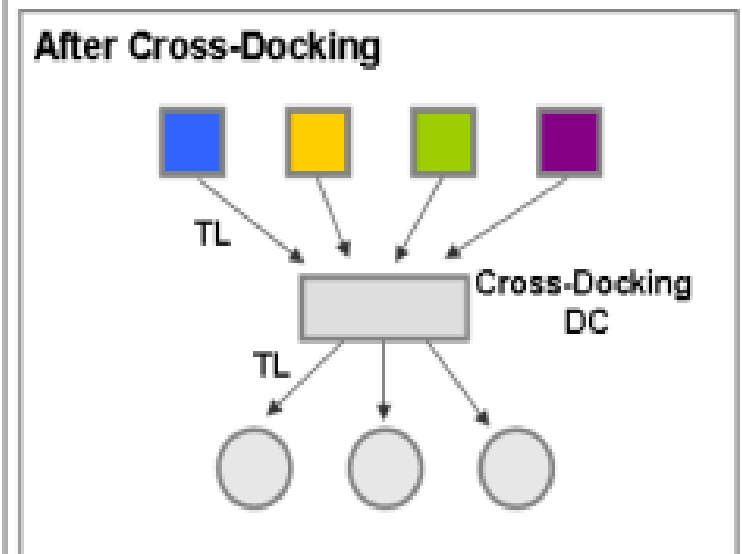
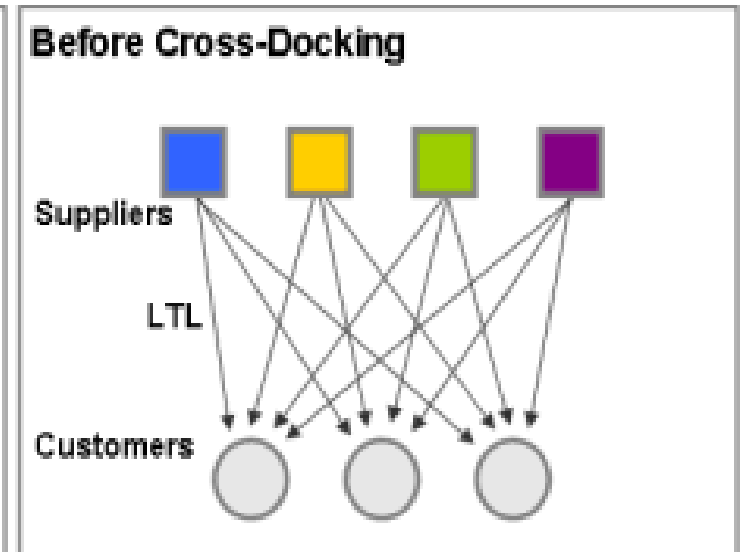
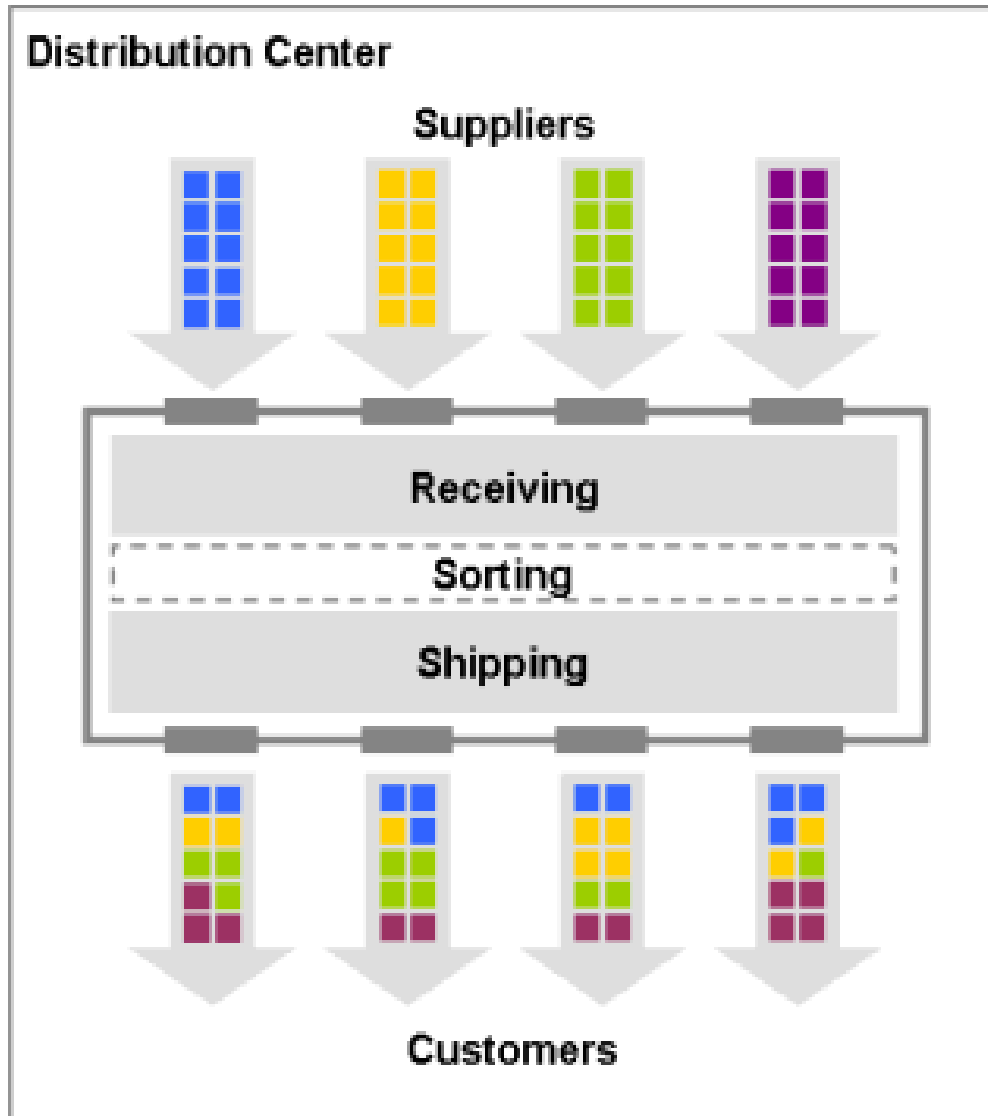
Cross Docking

- Fast, responsive & efficient transport system
- Reduces handling & storage of goods, enables direct to store shipments
- Reduce transportation cost by eliminating costly Less-Than-Truckload (LTL) shipments
- Used extensively for processing import containers at US ports
- Wal-Mart (The world's biggest retailer) delivers about 85% of its merchandises using a cross-docking system

Cross Docking Applications

- Manufacturing - consolidate inbound supplies to support just-in-time assembly (e.g. parts for different stages of an assembly line).
- Distribution - consolidate inbound products from different suppliers for delivery to customers.
- Transportation – sort & consolidate shipments from several suppliers to achieve Full-Truck-Load (FTL) economies of scale.
- Retail - receive products from multiple suppliers, then sort and mix them for direct outbound shipping to different stores.

Cross Docking



The Top 12: The most commonly used DC metrics

Metric (by rank in 2013 survey) and category	2012 Rank	2011 Rank
1. On time shipments (Customer)	1	1
2. Internal order cycle time (Customer)	5	6
3. Dock-to-stock cycle time, in hours (Inbound operations)	4	5
4. Total order cycle time (Customer)	6	7
5. Order picking accuracy (Quality)	2	3
6. Lines picked and shipped per hour (Outbound operations)	8	8
7. Lines received and put away per hour (Inbound operations)	11	9
8. % of supplier orders received damage free (Inbound operations)	12	10
9. Average warehouse capacity used (Capacity)	3	2
10. Order fill rate (Outbound operations)	*	*
11. % of supplier orders received with correct documentation (Inbound operations)	*	*
12. Peak warehouse capacity used (Capacity)	7	4

* Did not appear in Top 12



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Important Warehouse/Distribution Center Decisions

Important Warehouse/Distribution Center Decisions

- Site selection
- Design
- Layout
- Security
- Safety
- Maintenance
- Ownership arrangements
- Bonded

Site Selection

- ❑ Adopt a network optimization perspective
- ❑ Determine selection criteria
 - Distance to key markets, supply points
 - Average transit time
 - Proximity to transport hubs, major corridors
 - Availability of carriers
 - Skill & cost of labor pool
 - Economic incentives
 - Land & construction cost, utility cost
- ❑ Identify general area and specific location

Design

Main design factors

“Design for the Future While Building for Today”

- Cube utilization (height generally 8-30m, limited by material handling equipment's safe lifting capability)
- Product flow (facilitate continuous straight product flow through building)
- Product mix (assortment, demand pattern, weight, cube, packaging, inherent characteristics)
- Number of floors (single level is most efficient, but multilevel operations is important in high land cost areas like Hong Kong)
- Expansion plan
- Handling system

Layout

Main layout factors

- Facilitate product flow (receiving, storage, pick/pack, shipping)
- Standard internal pallet size
 - Package size and weight
 - Package stacking pattern
 - Package strength
 - Industry practice
- Anticipated external pallet size used by customers and suppliers
- Pallet positioning
- Slotting plan
- Handling equipments (e.g. fork lifts, tow lines, conveyer system)
- Value added activities

Security

“Good security prevents loss and damage as a result of a conscious act.”

Main security factors

- Pilferage
- Damage
- Sabotage
- Special handling for controlled substances & weapons
- Compliance with regulation

Safety

“Good safety prevents loss and damage as a result of an accident.”

Main safety factors

- Risk assessment
- Accident prevention
- Incorporate safety in work procedures
- Elimination of unsafe conditions
- Continuous safety training
- Compliance with regulation
- Audits

Maintenance

“An ounce of prevention is worth a ton of cure”

Main maintenance factors

- Preventive, predictive or reliability-centered
- Focus on up time
- Collect & mine performance data
- Good maintenance improves safety & security

Ownership Arrangements

Main ownership arrangements factors

- Private (high volume, important products, stringent fulfillment requirements, value added services)
- Public (low volume, less important products, less stringent fulfillment requirements, new to market)
- Contract (public warehouse/distribution center dedicated to a single or limited number of shippers)

Bonded Warehouse

“A bonded warehouse is a building in which dutiable goods may be stored or manipulated without duty payment”

Private bonded warehouses:

- Upon entry of goods into the warehouse, the importer and warehouse proprietor incur liability under a bond
- This liability is generally cancelled when the goods are exported, withdrawn for consumption domestically after payment of duty or destroyed.
- Compliance with Customs regulation and programs is critical.



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Temperature Controlled Warehouse & Distribution Centers

Products that Require Temperature Control Storage

- Food – fruits, vegetable, meat, prepared food
- Horticulture - flower, indoor house plant, bare root plant
- Beverages – wine, beer, juice, bottled water
- Pharmaceuticals – bio-engineered drugs, antibiotics, experimental drug compounds
- Medical products - IV solutions
- Specialty chemicals
- Water based paint & adhesives

Food Shelf Life & Optimal Temperature

Product	Shelf Life (Days)	Optimum Temperature (Celsius)
Apple	90-240	0
Bananas	7-28	13.5
Bell Peppers	21-35	7
Cabbage	14-20	1
Eggs	180	1.1
Onions	30-180	1
Lettuce	12-14	0.6
Fresh Meat (beef, lamb, pork, poultry)	14-65	-2
Oranges	21-90	7
Pears	120-180	-0.6
Potatoes	30-50	10
Seafood (shrimp, lobster, crab)	120-360	-17.8
Strawberries	5-10	0.6
Tomatoes	7-14	12

Temperature Controlled Storage Range

Slightly chilled (2 C - 10 C)

- Vegetable
- Banana
- Antibiotics

Chilled (0 C - 2 C)

- Meat
- Dairy products

Frozen (-18 C)

- Prepared frozen food
- Popsicles

Deep frozen (-29 C)

- Ice cream

Room temperature (15 C – 22 C)

- Candy
- Sensitive instruments (e.g. susceptible to water condensation damage)

Protect from freeze & heat (2 C - 25 C)

- Beverage
- Water based chemicals

Design Target for Cold Storage

- Effective temperature control to extend product life (e.g. lengthen product freshness, prevent spoilage)
- Tight seal of openings when inert gas is used
- Safety & security
- Integrity & trust in chain of control
- Traceability of product movement
- Temperature monitoring device for different areas
- Achieve successful balance between maintaining the right temperature and maintaining high throughput
- Flexibility in reconfiguring space (must take different product temperature requirement into account)

Cold Storage Best Practices

- Plan for degraded performance of battery operated instruments and material handling equipment
- Maximize the cube with dense storage
- Control cold air loss - use automated system and minimize entry/exit openings
- Use automate palletizing systems that can operate in frozen environment
- Use modular curtain wall system to divide warehouse into multiple temperature zones (flexible, low-risk option for handling product mix that changes with the season)
- Minimize time product is staged in receive and shipping areas
- Scheduled audit of handling and storage hygiene to assure product safety

Cold Storage Best Practices

- Know your market – customer needs & preferences, competitive dynamics, market trends, key profit drivers.
- Refrain from overbuild, basic cellars may be adequate for most villages, (e.g. storage of Hami melon in XUAR)
- Diversify customer base (e.g. a mixture of long term/short term storage arrangements)
- Location close to product supply source or primary consumption market, transport networks (road, rail, air & water) and low cost power supply network is important.

Example: Americold frozen French Fries storage adjacent to potato field. Chilled cut flower storage next to airport.



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***Proven Approaches for Earning
Extra Profit***

Profitable Value Added Services

- Customs clearance (on-site Customs office creates a competitive advantage)
- Inbound & outbound transportation management
- Quality inspection
- Cross-docking
- Order-fulfillment
- Labeling & tagging
- Packaging
- Kitting
- Cleaning
- Repair & maintenance
- Light assembly
- Returned goods processing
- Collecting, analyzing & reporting data



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Warehouse Bypass Ideas

Warehouse Bypass Ideas

- Use slower means of transport to store product (e.g. rail transport). When planned properly, this ensures goods produced at different times arrived destination simultaneously. (e.g. holiday gift packs)
- Use rail wagons, ocean containers for short term storage of goods until need date (e.g. construction)
- Use insulated trailers to gradually “defrost” product during transport to eliminate thawing time at destination cold storage (e.g. frozen orange juice thaw enroute to arrive mixing plant in slush liquid state for mixing)
- Plan and assemble loads for direct delivery to store or consumption point (e.g. assortment of toys cross docked in Shenzhen for direct delivery to US stores)
- Sell products from containers & trucks (e.g. wine grapes and Christmas trees are stored & sold from trailers in US)

“Long and uncertain cross border time restricts warehouse bypass and storage in transit”



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Future Developments

eCommerce Support

Delivering eCommerce products

- Direct to home
- Store fulfillment (e.g. store to home or same day pick up from store)
- Direct to store for pick up or delivery using crowd sourcing methods (e.g. Wal-Mart using pre-screened shoppers for delivery)
- Direct to convenient pick up centers (e.g. Amazon dropping off merchandise at lockers located in convenience stores)

Key issue: should eCommerce be handled in separate distribution network or same network that serves stores?

Vendor-Managed Inventory (VMI)

Basic principles:

- The supplier and its customer decide which products are to be managed using the customer's distribution centers.
- An agreement is made on reorder points and economic order quantities for each of these products.
- As these products are shipped from the customer's distribution center, the customer notifies the supplier, by SKU, of the volumes shipped on a real-time basis.
- Using such “pull” data, the supplier is responsible for maintaining proper inventory

VMI Shifts Business Inventory from Retailer to Manufacturer & Wholesaler



Source: U.S. Department of Commerce, Census Bureau



Thank You!

Andy Sze
Fastraxx Group, LLC

ADB Transport & Logistics Consultant

andyszeadb@gmail.com

+1 (239) 596 7211