**Dragon Duds Warehouse: As-Is Description**

(Based on the CICMHE 2005-2006 Material Handling Design Competition case)

Dragon Duds (DD) is an enterprise that imports style goods from Asia and sells them through a network of 500 retail store, primarily located in strip malls and shopping centers.

**Context**

DD procures product from suppliers in Asia and the product is delivered in cartons, floor loaded into containers (40’x8’x8’6”) that are delivered to the warehouse by container carriers. For each SKU, DD will determine an initial stocking for each store, assemble an order for the store consisting of full cartons, and ship (“push”) the order by LTL carrier. Some stock is held back at the distribution center to resupply stores where the SKU is selling well. Store replenishment orders are assembled in mixed cartons and shipped (“pulled”) to stores via a parcel carrier.

DD is adding 50 stores per year and expects to continue at that rate for the near future. Sales per store is expected to increase at a rate of 5% per year for the near future, for both existing and new stores.

**Product**

DD maintains a product line containing approximately 1000 style goods SKUs. As new SKUs are introduced, old SKUs are retired. Prior to a season, DD will place a single order for each SKU. This order will be filled by its supplier in several or many partial shipments. Partial shipments from several suppliers are combined by a freight forwarder to fill a container. On average, a container will have 16 SKUs and 792 cartons. On a peak day, at most 11 containers will be received; during a peak week, the average will be 7 containers per day.

The cartons range in size from 16” x 12” x 8” (48 cartons/pallet) to 28” x 18” x 12” (16 cartons/pallet).

The average push order is 4.3 lines, occupying 20.2 cubic feet on a standard pallet. There are approximately 2 push orders per store per week.

The average pull order is 7.5 lines, occupying 2.3 cubic feet in a mixed carton. There are approximately 5 pull orders per store per week.

**Process**

DD operates a single shift, from 8 am to 5 pm. Receiving occurs between 8:00 and 11:30 am. Carriers arrive between 2 and 4:30 pm.

Containers are unloaded by stacking cartons onto a mixed pallet, then moving the pallet to a sorting area where cartons are sorted to individual pallets by SKU.

Inventory is tracked in terms of cartons; to convert to pallets, the average pallet is assumed to contain 24 cartons and is about 50 cubic feet in volume.

When a sorted pallet is full, or no more of that SKU is expected to be delivered in the same day, the pallet is moved by lift truck to either floor storage or pallet rack. A SKU is stored in either floor storage or pallet rack, but not both.

Large inventory items are floor stored, stacked 2 high. Lower inventory items are stored in 2 deep pallet rack.

Push order cartons are single-order picked from both floor and pallet rack store to a manual pallet jack. Completed orders are moved to the shipping area for checking, wrapping and shipping documentation. Completed orders are staged on the floor near the shipping dock for pickup by an LTL carrier.

Pull order eaches are single-order picked from both floor and pallet store to a rolling basket. Completed orders are moved to the shipping area, where items are checked and packed in an appropriate carton. Once complete the carton is sealed, shipping documentation is prepared, and the carton is placed on one of five parcel carrier specific pallet. When a carrier-specific pallet is full, it is moved to a parcel carrier pickup area and replaced with an empty pallet.

Only 1/3 of the staged shipments will be picked up by carriers on average, so on average, a carton can remain in the shipping area for 2.3 days.

**Resource**

DD occupies half of a 320,000 square foot building. The clear height is 32 feet and the 12 inch square columns are spaced 40’ by 50’. The lease cost is $7.50/ft/year and there are 5 years left on the lease. In the near future, the other 160,000 square feet will be available at the same rate, to terminate at the same time as the current lease. The current space has 11 dock doors and a ramp; the potential additional space has 10 dock doors and no ramp.

Manual pallet jacks (10) are used for unloading containers and assembling push orders.

Counterbalanced lift trucks (6) are used for moving pallets into and within floor storage (to replenish the picking location), as well as moving pallets in shipping.

Deep reach trucks (3) are used for moving pallets into and within (to replenish a picking location) pallet rack storage.

Floor storage lanes are 7 pallets deep with (12 foot) aisle access from either end. Thus, the floor storage can be anything from 1 pallet to 13 pallets.

Double-deep pallet rack is access from (12 foot) aisles.

Packing area consumes 8000 sq. ft.

Corrugated storage consumes 900 sq. ft.

**Operational Control**

Approximately 1000 push orders are processed each week, an average of 2 per store. The marketing department knows how much of each SKU has been ordered, how much has been received, how much has been shipped to stores and how much remains in inventory. Before the first receipt of a SKU, a decision is made regarding how much to push to stores and how much to hold back. The push quantity is allocated among the 500 stores (NB: some stores may not get an allocation, based on location and demographics).

Twice a week, the marketing department creates push orders for each store by considering the store allocation for each SKU, how much of that SKU has already been shipped to the store, and how much of that SKU is currently in stock. Push orders are released on Monday and Wednesday at 8 am and must be ready for shipping by Friday at 2:30 pm.

Replenishment orders are received from stores all during the day. Anything ordered today before 1 pm is shipped today, otherwise it is shipped tomorrow.

Currently, inventory turnover is 3.5 turns/yr, but DD expects to improve that to 7 turns/yr over the next five years through a supply chain optimization program.

**Motivation**

In addition to the projected growth of stores and sales, there are issues with the existing DD distribution center.

* Picking productivity is low.
* On peak receiving days, product is staged in the aisles creating congestion that interferes with picking and replenishment operations.
* Product damage from crushed cartons

**Design question**

The existing distribution center is inadequate to support future growth. Should the existing space be retained, or should the additional space be leased? For each option how should the distribution center be designed and operated to accommodate future growth?

**Profiling data**

A table with numbers and a number of days

Description automatically generated

A chart with numbers and a number of pallets

Description automatically generated

A table with numbers and a number of pallets

Description automatically generatedA blueprint of a building

Description automatically generated