Fair Traders Storage/Retrieval Layout and Design

IEM 5203 Term Project

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Introduction

Fair Traders is a trade organization that sources materials from across the world, seeking to provide work for artisans in poorer parts of the world.

- Currently services primarily retail outlets.
- Has a growing direct-to-customer business.
- All products are shipped to a distribution center in New York City, where customer/vendor orders are processed and shipped.

Objective

- Create a new layout for the direct-to-customer (DTC) areas that satisfies the following:
  - Supports a growth in DTC orders of 25% in one year
  - Supports a growth in DTC orders of 35% in two years
  - Improves the productivity and throughput of the DTC order fulfillment process
- The following factors are also considered for this project:
  - Capital cost
  - Workforce needs
  - Warehouse management system requirements

Assumptions

The following assumptions were made for this project:

- All data is correctly organized and complete
- Only storage data for the DTC areas of the facility store information on DTC products
- The scope assumption that the Warehouse Management System (WMS) does not hold locations for items once empty implies that Free Traders currently uses a random storage policy.
- The storage bins in the E-Commerce order processing area are available for assignment.

Overview of the Team's Approach

To develop a solution for Fair Traders, the team performed the steps outlined below:

- Analyzed Data for understanding current state
- Determined a storage policy based on available data
- Determined an order picking policy based on layout and storage policy
- Estimated implementation costs and impact of recommended strategies

Why design as per the outbound data?

The case provides us data for two main activities – **Receiving** and **Outbound**.

Team selected the Outbound data as the basis of layout design.

Design with outbound is preferred because it helps analyze the strategy as per the actual volume shipped out of the warehouse.

Also, the outbound/demand implies quantity/volume of items that will be procured from the suppliers.

Also, design as per outbound gives the management a chance to reorganize the procurement strategies that are used in the current process.

Data Analysis

Because of the size of the data, summary PivotTables were utilized to extract relevant data. This gave insight into the following metrics:

- From BinContent: Average Monthly Inventory
- From OutboundFull: Item order quantity and volume for each item
- From Bins: Total storage space in each area of the DTC sections of the facility

These metrics allowed the team to determine that the center turns its inventory over about 15 times per year.

This allowed the team to then estimate the volume requirement for each item in the facility based on the ratio of average monthly inventory to total items output over the 14-month data horizon.

Data Analysis

From this information, it was found that item popularity in the DTC department largely follows a Pareto principle.

Choosing a Storage Policy

From the data on storage space and average inventory, the team found that Free Traders has sufficient storage space for their DTC operations.

Because of this and the desire to keep capital costs low, storage policies were considered using the current facility layout.

Since the current system is randomized, dedicated and class-based storage systems were considered for Free Traders.

The large number of items in the facility makes a dedicated policy with a high service level infeasible. Thus, the team decided to implement a class-based storage policy with mixed bins.

Number of Classes

For this storage policy, the team desired to use the two-tier layout to determine class locations and assign items accordingly.

Since all DTC order processing is done on the Mezzanine level, this level was assigned class A.

The lower level was split into two classes based on proximity to the elevator.

Items will be assigned based on their throughput to storage ratio.

Throughput calculated based on quantity ordered, storage calculated based on the volume of that quantity.

Service Level

Targeted a 95% service level for Classes A and B, as they would constitute a vast majority of items shipped by Fair Traders.

Class C's service level would be determined by the available space for items. It is expected that this service level should be 80% or higher for at least the next year, based on growth forecasts.

Information on mean and standard deviation for each item class proved infeasible to gather based on hardware restrictions (would require a for loop with 10^{10} iterations!).

Because of this, an estimate of 1.7 times aggregate demand was used.

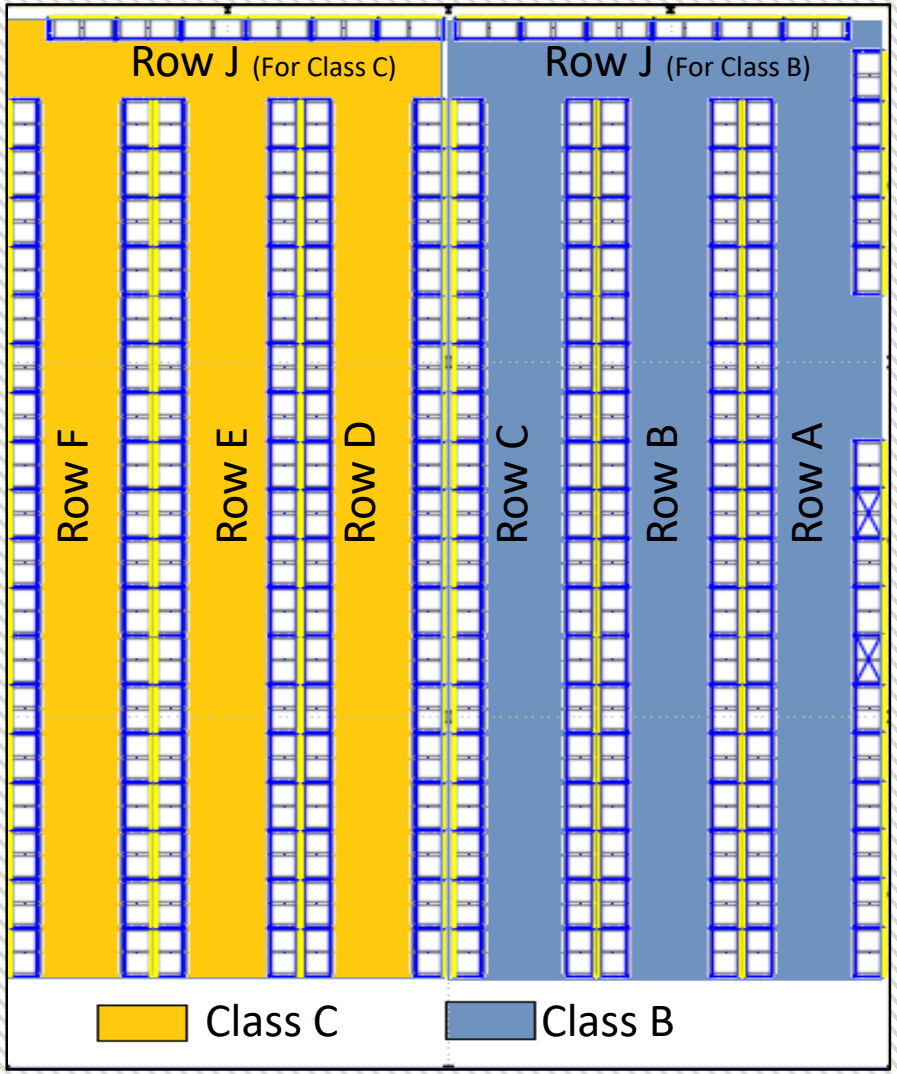
Assigning Classes

After performing these calculations, items were assigned classes using the following method:

- Sort items by T:S ratio
- Calculate cumulative storage requirement (CSR) for each item
- If an item entry's CSR is below $\frac{1}{1.7}$ times the space available on the Mezzanine, assign to Class A.
- If an item entry's CSR is below $\frac{1}{1.7}$ the space available in classes A and B, assign to Class B.
- Else, assign the item to Class C.

Based on this, it was found that Fair Traders will run out of room to meet average demand for Class C near the end of the 2-year planning horizon.

Recommended Layout – Main Level



Class B

Dedicated bins for Class B items include that on Main level.

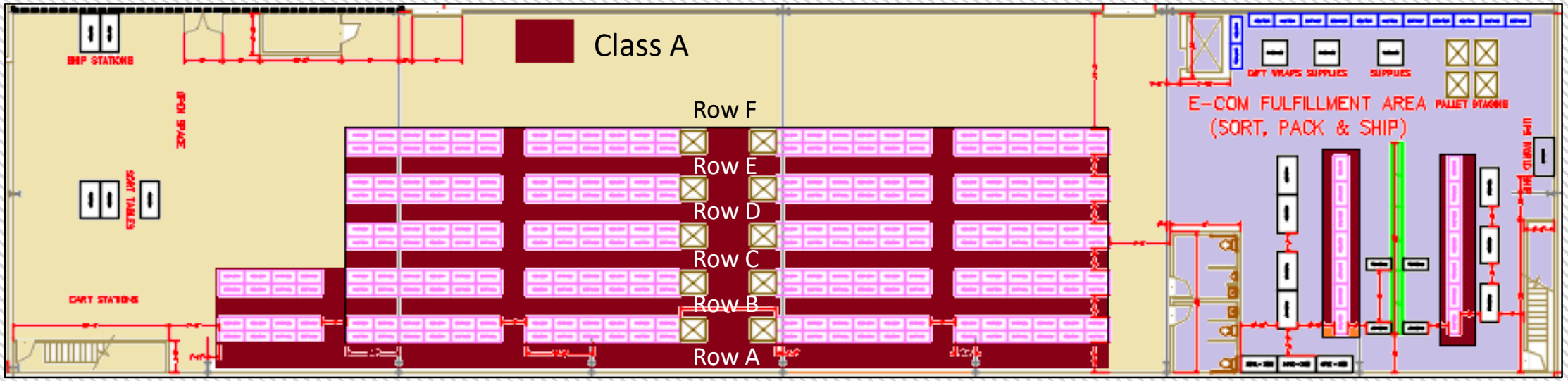
Row A, Row B, Row C and Row J (1J03 – 1J13) are dedicated to Class B items.

Particularly large size items are preferred to be assigned along the walls

Class C

Dedicated bins for Class C include that on Row D, Row E, Row F and Row J (1J14 to 1J34)

Recommended Layout – Mezzanine Level



Class A

Dedicated bins for Class A items include that on the mezzanine level.
Row A to Row F at the mezzanine level are dedicated to Class A items
As all packing stations are located at the mezzanine level, it helps avoid bottle neck at the elevator.

Storage Layout Strategy – Validation

DTC consists of 3 channels – Wholesale, Festivals, and E-Commerce.

A common notion would be to classify the layout as per the customer group and demand. However, findings were otherwise.

From the data, 20.7% of items shipped by Free Traders were only ordered by one customer group. These items only accounted for 5.0% of all orders shown in the data.

Hence, data aggregation solely on the item demand volume was a better strategy to locate the items as per throughput.

This strategy is a major contribution to avoid bottleneck at the elevator as high demand items are stored near the packing stations. This enables low distance travelled for maximum demand volume items.

Order Picking Strategy - Overview

The team identified that current warehouse operation does not have a clear strategy for the entire warehouse. Currently, only the mezzanine level has a defined strategy

On average, the costs of order picking may amount to 55% of operational costs in the warehouse.

Many different strategies were identified by the team such as:

1. Discrete Order Picking
2. Zone Picking
3. Batch Picking
4. Cluster Picking
5. Wave Picking

Order picking strategy implemented

Upon data analysis and reviewing different strategies team decided different strategies for mezzanine and First floor

The reason for different order picking strategies for different floor was due to different flow of items as a result of class-based storage.

For mezzanine level, a zoning strategy would be implemented

For the first floor a batching strategy would be implemented, with a class-based zoning strategy option available should orders have many items from class B or C.

Order picking for Mezzanine floor

Mezzanine floor contains mainly fast-moving items, so zoning strategy would be used for order picking.

In zoning, the team believes a Bucket Brigade approach should be implemented.

Bucket Brigade approach was chosen since its nature of being self balancing with respect to workload.

Also this approach would allow increase in throughput rate thereby increasing service level of the warehouse.

This approach is also relatively simple to understand and learn for workers.

Order picking for First floor

The first floor contains two classes that have lower T:S ratios.

Because of this, a batching strategy is believed to be best.

This strategy keeps orders together and allows any material handling devices to be better utilized since orders do not have to be passed from one worker to the next.

For peak season or other times where lower level items are in higher demand, a zone picking strategy based on classes could also be used, with one class for each zone and one class for items large enough to require a material handling device.

Order Picking Enhancements

Currently a picker to part approach is being suggested by the team.

An advancement to augment this approach can be implemented by using a Voice-Pickup Management System (VPMS).

The VPMS, connected to existing warehouse systems, would monitor the data of each order and its storage and retrieval of items from the warehouse.

Upon order fulfillment, a headset given to each picker with would communicate order information and guide the picker to each part location.

Other Considerations

- To reduce elevator bottleneck, picking scheduling should be coordinated with inbound shipping schedules so that the elevator is available to transport new items to the mezzanine.
- The WMS will need additional functionality to track item locations for mixed bins and to assign items to zones.
- There is an open area near the spiral chute of the mezzanine level that could be used for additional shelving space in the future.
- The storage shelves in the E-Commerce processing area should store the necessary dunnage for those orders.
- The new storage system keeps popular items on the mezzanine, reducing the load on the elevator during order picking.
- Picking policies are relatively simple and can be easily taught if temporary workers are needed in peak season.

Summary of Recommendations

Based on the team's research and calculations, we recommend the following:

- Implement a 3-Class storage policy, with Class A on the mezzanine, Classes B and C on the main level.
- Use a batch picking strategy for the mezzanine level and a zone picking policy for the main level.
- Consider buying additional shelves for the open space on the mezzanine level after 1 year, based on updated forecasts.

Estimated Cost of Implementation

- Based on inventory turnover information, the team believes that implementing this solution would require 2 weeks of warehouse closure.
- This time would be used to move items according to the class storage policy, train workers on the picking strategy, and update the WMS to support the new system.
- No storage racks are being moved, so external labor should not be necessary.
- If this closure is performed outside the peak season (i.e. in spring or early summer), this would result in 2% of orders for the year to be delayed or lost based on historical data provided by Fair Traders.

Expected Benefits

- Increased order fulfillment efficiency due to moving high throughput items closer to fulfillment areas.
- Increased worker productivity due to clear order picking strategies and voice pickup management system.
- Decreased elevator usage due to leaving lower throughput items on the lower level and restocking based on scheduled deliveries.
- Increased efficiency in storage due to allowing mixed bins.