Data Documentation

Livlina Start-up 3

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In this document, comprehensive details are provided regarding the variables of interest that were utilized throughout the analysis. As a result of extracting relevant subsets and performing necessary feature engineering, the two main datasets created are: Inbound and Outbound.

1 Inbound data

In the following section, detailed information is provided for each variable utilized in the inbound dataset.

- Number of pallets(Frigo and Room temp)
- Total number of pallets
- Number of orders(frigo,Room temp)
- Number of workers
- Total number of orders
- Estimated Number of workers
- Actual Number of workers
- Workload

1.1 Number of pallets(Frigo,Room temp)

This variable shows the total number of pallets for each day. This was obtained by counting each row of the dataset as a pallet. The receiving lines data set was used for this.

1.2 Total number of pallets

This variable indicates the total number of pallets in inbound and frigo zone.

1.3 Number of Trucks(frigo, Room temp)

This variable represents the number of trucks grouped by date within the inbound and frigo zone. To derive this information, the inbound tijdslotten dataset has been utilized.

1.4 Number of workers

This variable represents the daily number of employees in inbound zone. The estimation of this variable relied on planning datasets from both 2022 and 2023.In order to refine the estimation of the number of workers for inbound tasks, the dataset can be effectively filtered based on criteria such as inbound, frigo, L&Ł, and onthaal.

1.5 Total number of orders

This variable is derived as the sum of the number of orders in Frigo and Inbound.

1.6 Estimated Number of workers

We estimated the number of workers each day by assuming that each worker spends an average of 8 hours on the job. After adjusting for *Safety factor* impact on the job by subtracting 5mins from each hour, we calculated that on average each worker works for 7hrs 20 mins. Therefore, workload for each day was divided by 7.333 to estimate the number of workers (Man Power) required.

1.7 Actual Number of Workers

Extracted from the Planning dataset, reflecting the company's planned number of workers for each day in different zones.

1.8 Workload

Calculated using information from the "Info Capacitein"file, estimating workload hours for loading ,unloading,inbound desk,inbound floor,packing check and infeed.

1.8.1 Loading and unloading

For a set of 33 pallets, the cumulative time required is approximately 45 minutes, averaging to roughly 1.36 minutes per pallet.

1.8.2 Inbound desk

the Inbound Desk Time is calculated based on a 10-minute duration per batch, with each batch handling 50 pallets, resulting in an allocation of 0.2 minute per pallet for inbound desk operations.

1.8.3 Inbound Floor time

Time for each pallet is 2 minutes.

1.8.4 Packing Check Time

The Packing Check Time is determined at 0.3 minute per pallet, calculated based on a 15-minute duration per batch,which each handling 50 pallets.

1.8.5 Infeed Time

The infeed Time is set at 2 minutes per pallet.

The duration across all stages were aggregated, enabling the calculation of the time allocated for each individual pallet accordingly (the time was divided by 60 to represent it in hours).

2 Outbound data

The following variables were engineered for the Outbound zone: This data was taken from the Orderlines data and the Inboud Tijdslotten dataset. Here, detailed information is provided for each variable utilized in the outbound dataset.

- Order Date
- Number of pallets
- Number of colli
- Workload (hrs)
- Total number of pallets
- Number of Orders
- Order Frequency
- Estimated Number of workers
- Actual Number of workers

2.1 Order Date

Indicates the daily count of pallets from July 2022 to June 2023, sourced from the orderlines dataset.

2.2 Number of Pallets

Derived from the Orderlines dataset, this metric signifies the count of pallets per order date, calculated by summing pallets per unique order number.

2.3 Number of Colli

Represents the count of colli per order date, obtained from the Orderlines dataset by summing colli per unique order number.

2.4 Workload (hrs)

Calculated using information from the "Info Capacitein" file, estimating workload hours for internal transport, depalletizing, OSR picking, manual picking, manual replenishment, and pallet wrapping.

2.4.1 Picking

To obtain the workload for picking, the orderlines dataset is merged with the with the Bundle Item and Item overview dataset by the Product Number. After which, for those with ChildQty, the QtyActual for each Orderline was divided by the ChildQty to get the full case and single unit case picked. We furtherly splitted the combined dataset into 2 parts; Automated and Manual picking

- **Automated Picking:** For the automated picking, the full case pick is ignored since this is done by the robots. The single unit picked not by the robot is grouped and counted by their orderlines. Then summed over each unique day (order_date). This gives the quantity picked in the OSR and converted to time in order to estimate the workload.

  The workload for automated picking is derived by merging the Orderlines dataset with the Bundle Item and Item Overview datasets using the Product Number. For items with Child Quantity, the QtyActual for each Orderline is divided by the Child Quantity to determine the full case and single unit case picked. The single unit cases not handled by robots are grouped, counted by orderlines, and summed over each unique day (order_date). This quantity is then converted to time using the formula:

$$S_i = \frac{o_i \times 60}{200}$$

  The result is further divided by 60 to express it in hours.

- **Manual Picking:** The manual picking workload is calculated by splitting the dataset into full case and single unit picking. Each category is then grouped, counted by orderlines, and summed over each unique day (order_date). The quantity for full case and single unit picking is converted to time to estimate the workload.

  Let MS_i represent single unit manually picked:

$$MS_i = \frac{o_i \times 60}{40}$$

The result is further divided by 60 to express it in hours.

Let MF_i represent full case manually picked:

$$MF_i = \frac{o_i \times 60}{80}$$

The result is further divided by 60 to express it in hours.

2.4.2 Internal transport

The time for moving pallets within the warehouse is estimated as 10 minutes per pallet

2.4.3 Depalletizing

Depalletizing for both automatic and manual is 120 pallets a day. When converted to minutes, this averages an estimate of about 4 minutes per pallet.

2.4.4 Manual Replenishment

This time is estimated as 5 minutes per pallet

2.4.5 Pallet wrapping

This is estimated as 15 pallets per person

The duration across all stages were aggregated, enabling the calculation of the time allocated for each individual pallet accordingly (the time was divided by 60 to represent it in hours).

2.5 Total Number of Pallets

Obtained by adding the number of pallets and the number of colli, with 50 colli assumed to be equivalent to 1 pallet.

2.6 Number of orders

Represents the count of orders made per day, calculated by counting unique orderlines received each day.

2.7 Order frequency

Categorizes order frequency as high, medium, or low based on mean order values per day. Categorizes order frequency as high, medium, or low based on mean order values per day.

Let P_i rep the mean of the orders

$$\mathrm{P}_i = \frac{\sum o_i}{n}$$

(1)

If $o_i > P_i$, "high" order,
If $o_i > \frac{P_i}{2} < P_i$, "medium" order
Else it is a "low" order

2.8 Estimated Number of workers

We estimated the number of workers each day by assuming that each worker spends an average of 8 hours on the job. After adjusting for *Safety factor* impact on the job by subtracting 5mins from each hour, we calculated that on average each worker works for 7hrs 20 mins. Therefore, workload for each day was divided by 7.333 to estimate the number of workers (Man Power) required.

2.9 Actual Number of Workers

Extracted from the Planning dataset, reflecting the company's planned number of workers for each day in different zones.